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MICROFUNGI ASSOCIATED WITH THE WOOD-BORING BEETLES SAPERDA CALCARATA (POPLAR BORER) AND CRYPTORHYNCHUS LAPATHI (POPLAR AND WILLOW BORER)

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ABSTRACT

Fifty-six taxa in forty-two genera are reported from wood-boring beetle activity of the long-horned beetle *Saperda calcarata* (poplar borer) (Coleoptera: Cerambycidae) and weevil *Cryptorhynchus lapathi* (poplar and willow borer) (Coleoptera: Curculionidae) during a study designed to assess the distribution of the yeast genus *Ascobotryozyma.* Regular collections from wounds, frass, galleries, and larvae in *Populus tremuloides* (trembling aspen) over 27 months revealed trends in fungal species composition in relation to gallery location and age of beetle damage. In *Salix*, fungi were identified only from galleries from which *Ascobotryozyma* was found; thirty-four taxa are reported. Fungi identified in this study are compared with those from other surveys and their roles within the trees and associations with other organisms are discussed.

KEYWORDS

beetle galleries, *Populus tremuloides*, aspen, *Salix*

INTRODUCTION

Studies on microfungi associated with *Populus* (aspen) (Salicaceae) and *Salix* (willow) (Salicaceae) wood span a variety of topics, including pathogenic interactions, the role of decay fungi, characterization of endophytic fungi, and comparisons of fungal taxa among tree genera and species. Because of the economic significance of *Populus* species for timber and pulpwood, most research has focused on disease (Anderson & Martin 1981; Callan 1998; Etheridge 1961; Hinds 1981; Hinds & Laurent 1978; Manion & Griffin 1986) and decay fungi (Basham 1958; Eslyn & Lombard 1984; Good & Nelson 1962; LaFlamme & Lortie 1973; Lindsey & Gilbertson 1978; Thomas *et al.* 1960; Wikström 1975). Several studies, however, have examined the wood-inhabiting microfungi from healthy tissues of *P. tremuloides* Michx. (trembling aspen) (Chapela 1989; Crane *et al.* 1996; Hutchison 1999; Hutchison & Hiratsuka 1994). *Salix* species are of little economic importance; studies on wood-inhabiting microfungi are limited to the identification of fungi in decaying logs (Eslyn & Lombard 1984) and endophytic species (Petrini & Fisher 1990; Sivak & Person 1973).

The associations of certain fungi with wood-boring beetles and their host trees have received much attention. Wood-boring beetles encompass a broad taxonomic range but are characterized by larvae that develop in wood, carving out galleries while feeding on woody tissues and associated microorganisms. Most of the research on beetle-associated fungi has focused on the blue-stain and ambrosia fungi, which are closely associated with specific beetle taxa referred to as bark beetles and ambrosia beetles, respectively. Little is known, however, about the passive, nonspecific dissemination of fungi by other types of wood-boring beetles.

The purpose of this research was to examine the fungi associated with wood-boring beetles in aspen and willow. Two wood-borers commonly occurring in the eastern Washington/western Idaho area of the northwestern United States, where this study was undertaken, include the long-horned beetle *Saperda calcarata* Say (poplar borer) (Coleoptera: Cerambycidae) in *P. tremuloides* (*e.g.* Johnson & Lyon 1991; Metcalf & Flint 1939) and the weevil *Cryptorhynchus lapathi* (L.) (poplar and willow borer) (Coleoptera: Curculionidae) in *Salix* species (*e.g.* Johnson & Lyon 1991; Smith & Stott 1964). The initial objective was to find isolates of a nematode-associated anamorphic yeast, *Botryozyma*, originally described from sour-rot of grapes in Italy (Smith *et al.* 1992) and also discovered in wood-boring beetle galleries in eastern Washington by J. D. Rogers. Collections made during this study yielded additional isolates, including the teleomorph, *Ascobotryozyma*, and two new species (Kerrigan *et al.* 2001; Kerrigan *et al.* in review). Filamentous fungi were also examined. In *P. tremuloides*, fungi were identified from periodic collections to record trends in species composition, while fungi were identified from *Salix* only when *Ascobotryozyma* was found. Fungi were described and photographed directly from isolation plates and no consistent effort was made to isolate and preserve them.

MATERIALS AND METHODS

Samples of frass and wood from *S. calcarata* activity were collected from one *P. tremuloides* stand approximately every six weeks over 27 months. The study site was located in Spokane County in eastern Washington (approximately 47° 19' N, 117° 60' W), where *Botryozyma* had been collected previously. Trembling aspen is the predominant tree species and the stand is probably clonal. Most collections were made from a 0.5 hectare area within the stand where infestations were prevalent. Wood plugs were extracted using an increment hammer from within and adjacent to entrance sites; associated frass was also collected. Typically samples were taken from 2-4 wounds per collection. Trees with heavy infestations were felled and split, and wood and frass were collected from galleries. No wound or gallery was sampled more than once. Similar gallery collections were made from infested *Salix* spp. throughout eastern Washington and western Idaho to obtain *Ascobotryozyma* isolates. If *Ascobotryozyma* was present, the associated fungi were identified.

Samples were plated onto Corn Meal Agar (Difco) (CMA), Malt Extract Agar (Difco) (MEA), scratch malt extract agar (SME) (2% w/v malt extract and 1.77% w/v agar), Potato Dextrose Agar (Difco) (PDA), and 2% Water Agar (Difco) (WA). Nutrient media were amended with lactic acid or antibiotics (penicillin-streptomycin). When necessary, pure cultures were generated on media on which taxonomic descriptions had been made by others, including CMA, MEA, PDA, 2% Oatmeal Agar (Difco) (OMA), rabbit food agar (RFA) (2.5% w/v commercial rabbit food, 1.5 w/v% agar), and synthetischer nährstoffärmer agar (SNA) (Nirenberg 1976). Plates were incubated at room temperature (22-25°C) in ambient light.

Fungi were identified on the basis of morphological and cultural characters. Generic identifications were made using references by Barron (1968), Bell (1983), Carmichael *et al.* (1980), Domsch *et al.* (1980), O'Donnell (1979), and Sutton (1980). References used for species identifications, listed by taxa, are: *Acremonium* spp. (Gams 1971), *Arthrobotrys* spp. (Dreschler 1937; Oorschot, van 1985; Schenk *et al.* 1977), *Aspergillus* spp. (Domsch *et al.* 1980), *Aureobasidium* spp. (Hermanides-Nijhof 1977), *Beauveria bassiana* (Hoog, de 1972; MacLeod 1954), *Bispora betulina* (Ellis 1971; Matsushima 1985), *Cephalotrichum microsporum* (Kirk & Spooner 1984), *Ceratocystis moniliformis* (Gryllis & Seifert 1993; Upadhyay 1981), *Chloridium lignicola* (Gams & Holubová-Jechová 1976), *Cladosporium herbarum* (Vries, de 1952; McKemy & Morgan-Jones 1991), *Discohainesia oenotherae* (Palm 1991; Sutton 1980), *Exophiala* sp. (Hermanides-Nijhof 1977), *Fusarium solani* (Nelson *et al.* 1983), *Gymnoascus reessii* (Arx, von 1986), *Hormonema dematioides* (Hermanides-Nijhof 1977), *Humicola grisea* (Fassatiová 1967), *Mucor circinelloides* f. *circinelloides* (Schipper 1976), *Ophiostoma* spp. (Gryllis & Seifert 1993; Upadhyay 1981), *Pesotum* spp. (Okada *et al.* 1998; Okada *et al.* 2000; Seifert & Okada 1993; Upadhyay 1981), *Phialophora* spp. (Schol-Schwartz 1970; Yan *et al.* 1995), *Phoma* spp. (Sutton 1980), *Ramichloridium anceps* (Hoog, de 1977; Hoog, de *et al.* 1983; Schol-Schwarz 1968), *Rhinocladiella atrovirens* (Hoog, de 1977; Hoog, de *et al.* 1983), *Rhizopus stolonifer* var. *stolonifer* (Schipper 1984), *Sporormiella cymatomera* (Ahmed & Cain 1972), *Triadelphia heterospora* (Constantinescu & Samson 1982; Shearer and Crane 1971), *Trichurus spiralis* (Domsch *et al.* 1980; Hasselbring 1900), *Ulocladium atrum* (Simmons 1967, Simmons 1998), *Verticillium luteoalbum* (Hughes 1951; Subramanian 1971). Identifications of the yeasts *Ascobotryozyma* spp., *Pichia membranaefaciens*, and *Williopsis saturnus* were provided by the Centraalbureau voor Schimmelcultures.

Beetle larvae were extracted from *P. tremuloides* galleries and adults were trapped in wire mesh cages stapled over entrance sites. Larval and adult specimens were identified with references by Lawrence (1987) and Arnett (1963), respectively. The identity of the beetles in *Salix* was determined by examining adults, pupae, and larvae from galleries (Garbutt & Harris 1994; Harris & Coppel 1967).

RESULTS

Fifty-six taxa from forty-two genera (Table 1) were identified from approximately 75 samples from entrance sites, frass, galleries, and larvae of *S. calcarata* in *P. tremuloides* and from *C. lapathi* galleries in eight *Salix* trees. Identifications were made of fungi sporulating on wood and media. Although a few basidiomycetes were isolated, none were further identified. *Acremonium* sp. (1), *Aureobasidium pullulans*, *Fusarium solani*, *Pesotum* spp., *Pichia membranaefaciens,* and *Williopsis saturnus* were found in almost all of the isolations from beetle-damaged tissues of *P. tremuloides* and most collections from *Salix*. Species of *Aspergillus*, *Penicillium*, *Rhizopus*, and *Trichoderma* were frequently isolated from wounds and frass.

Wounds and frass harbored a variety of fungi, while galleries provided the opportunity to examine organisms closely associated with beetle activity. Most of the taxa listed are probably saprobes, although some appeared to be associated with other microorganisms. Eleven ophiostomatoid taxa, including *Ceratocystis moniliformis*, *Leptographium* spp., *O. populinum*, *Ophiostoma* sp., *Pesotum clavigerum*, *P. introcitrinum*, *Pesotum* spp., and *Pesotum* and *Sporothrix* synanamorphs, were identified from galleries and frass and/or cultured from larvae. A species of *Geotrichum*, an anamorph of endomycetous taxa and commonly associated with beetle galleries and slime fluxes (Hoog, de *et al.* 1986), was isolated once. *Beauveria bassiana*, a widespread, entomopathogenic species (Hoog, de 1972; MacLeod 1954) was isolated from one *S. calcarata* larva. *Pichia membranaefaciens* and *Williopsis saturnus* were cultured from *S. calcarata* larvae surfaces and guts. Three nematophagous fungi, *Arthrobotrys brochopaga*, *A. oligospora* var. *oligospora*, and *A. superba*, were isolated from wounds, frass, and galleries. *Ascobotryozyma americana* and *A. cognata*, both nematode symbionts, were isolated from the surfaces of nematodes associated with beetle activity.

The remaining taxa probably have a saprophytic role. Dematiacious hyphomycetes included *Alternaria* sp., *Bispora betulina*, *Chloridium lignicola*, *Cladosporium herbarum*, *Humicola grisea*, *Triadelphia heterospora*, *Ulocladium atrum*, and the synnematous *Cephalotrichum microsporum* and *Trichurus spiralis*. Black yeasts, including *Aureobasidium pullulans*, *A. pullulans* var. *melanigenum*,

Table 1. Fungi identified from *Populus tremuloides* and *Salix* spp.

	Location*	
Taxon	*Pop.*	*Salix*
Acremonium sp. (1)	w f g	w f g
Acremonium sp. (2)	–	g f
Alternaria sp.	w f g	w f g
Arthrobotrys brochopaga (Drechsler) S. Schenck, W. B. Kendr. & Pramer	w f g	–
Arthrobotrys oligospora var. *oligospora* Fresen.	w f g	w f g
Arthrobotrys superba Corda	–	w f g
Ascobolus sp.	w	w
Ascobotryozyma americana J. Kerrigan, M. T. Sm. & J. D. Rogers	w f g l	–
Ascobotryozyma cognata J. Kerrigan, M. T. Sm. & J. D. Rogers	w f	w f g l
Aspergillus niger Tiegh.	w f g	w f g
Aspergillus spp.	w f g	w f g
Aureobasidium pullulans (de Bary) Arnaud	w f g	w f g
Aureobasidium pullulans var. *melanogenum* Herm.-Nijh.	w f g	w f g
Beauveria bassiana (Bals.-Criv.) Vuill.	l	–
Bispora betulina (Corda) S. Hughes	w f g	w f g
Botrytis sp.	w f	w f
Cephalotrichum microsporum (Sacc.) P. M. Kirk	w f	–
Ceratocystis moniliformis (Hedgc.) C. Moreau	g	–
Chloridium lignicola (F. Mangenot) W. Gams & Hol.-Jech.	w f	–
Cladosporium herbarum (Pers.) Link	w f g	w f g
Discohainesia oenotherae (Cooke & Ellis) Nannf.	–	g f
Exophiala sp.	w f g	w f g
Fusarium solani (Mart.) Sacc.	w f g l	w f g l
Geotrichum sp.	w f	–
Gliocladium spp.	w	w
Gymnoascus reessii Baran.	w	–
Hormonema dematioides Lagerb. & Melin	w f	w f
Humicola grisea var. *grisea* Traaen	w g	–
Leptographium sp. (1)	w f	–
Leptographium spp.	w f	w g
Mucor circinelloides f. *circinelloides* Tiegh.	w f	–
Ophiostoma sp.	w f g	–
Ophiostoma populinum (T. E. Hinds & R. W. Davidson) de Hoog & R. J. Scheff.	g	–
Penicillium spp.	w f	w f
Pesotum clavigerum (H. P. Upadhyay) G. Okada & Seifert	g f	–
Pesotum introcitrinum (H. P. Upadhyay & W. B. Kendr.) G. Okada & Seifert	g	–
Pesotum sp. (1)	w f g l	w f g l
Pesotum sp. (2)	w f g l	w f g l
Pesotum/Sporothrix sp.	w f g l	–
Phialophora verrucosa Medlar	w f g	–

Table 1. continued

Phialophora sp.	w f g	w f
Phoma sp. (1)	–	w f
Phoma sp. (2)	w f	–
Pichia membranaefaciens (E. C. Hansen) E. C. Hansen	w f g l	w f g l
Ramichloridium anceps (Sacc. & Ellis) de Hoog	w f g	w f g
Rhinocladiella atrovirens Nannf.	w f g	w f g
Rhizopus stolonifer var. *stolonifer* (Ehrenb.) Vuill.	w f g	w f g
Saccobolus sp.	–	w f
Sporormiella cymatomera S. I. Ahmed & Cain	w g	–
synnematous sp.	w f g	–
Triadelphia heterospora Shearer & J. L. Crane	w f g	w f g
Trichoderma spp.	w f g	w f
Trichurus spiralis Hasselbr.	w f g	–
Ulocladium atrum Preuss	w g	w g
Verticillium luteoalbum (Link) Subram.	w g	–
Williopsis saturnus (Klöcker) Zender	w f g l	f g

* w=wound, f=frass, g=gallery, l=larva

Exophiala sp., *Hormonema dematioides*, *Phialophora* spp., *Ramichloridium anceps*, and *Rhinocladiella atrovirens* were frequently isolated. The coprophilous fungi *Sporormiella cymatomera*, *Ascobolus* sp., and *Saccobolus* sp. were also represented. The remaining, with various taxonomic affinities, included *Discohainesia oenotherae* (anamorphic Dermateaceae with discoid to cupulate conidiomata), *Gliocladium* spp. (hyphomycete with sticky spore masses), *Gymnoascus reessii* (ascomycete with a net-like peridium), Hyphochytriomycetes, *Mucor circinelloides* var. *circinelloides* (Mucorales), *Phoma* spp. (coelomycete), *Physarum* sp. (myxomycete with dark spores and calcareous capillitium), and *Verticillium luteoalbum* (hyphomycete).

DISCUSSION

Regular collections of poplar borer-damaged tissues in *P. tremuloides* revealed a number of organisms that were consistently associated with *S. calcarata* larvae. These organisms may have been introduced directly with the eggs or associated with egg deposition (*e.g.* introduced when the beetles cut into the wood, associated with nematodes introduced by the beetles, associated with nematodes introduced by the eggs). Young larvae in pristine galleries, in which the wood had not changed color, were covered with yeasts, including

Pichia membranaefaciens and *Williopsis saturnus*. Larvae chewed through and ingested the wood, but probably gained most nutrition from the yeasts; similar looking yeasts were isolated from larval guts. *Panagrellus dubius* Sanwal, a free-living nematode that feeds on yeast and bacteria (Sanwal 1960), was present in every collection. Occasionally, nematodes had *Ascobotryozyma* thalli attached to their cuticles (Kerrigan *et al.* 2001; Kerrigan *et al.* in review).

Galleries that were slightly discolored but appeared relatively new contained *Acremonium* sp. (1), *Aureobasidium pullulans*, *Fusarium solani*, *Pesotum* spp., and the yeasts *Ascobotryozyma americana*, *Pichia membranaefaciens*, and *Williopsis saturnus*, in addition to *Panagrellus dubius*. Frequently, nematodes were found trapped by *Arthrobotrys* species. In older, darkened galleries ophiostomatoid fungi were found lining galleries and readily formed on plated wood, frass, and larvae. The spores of these taxa are borne in slimy masses on the tips of stalks, adapted for dispersal by beetles and other arthropods, which were often observed in and near galleries. Many of these of fungi are pathogenic and probably contributed to the increased rate of degradation of woody tissues.

Over time, gallery wood became discolored due to fungal colonization and oxidation. Decaying wood and tissues closer to entrance sites generally harbored the most fungal taxa. Old frass and old galleries, especially those along the cambium, contained many fungi passively disseminated by air, wind, etc. Commonly encountered fungi, such as *Alternaria* sp., *Aspergillus niger*, *Aspergillus* spp., *Gliocladium* spp., *Penicillium* spp., *Rhizopus stolonifer*, and *Trichoderma* spp., were isolated from most tissues. Additional taxa included *Botrytis* sp., Hyphochytriomycetes, *Phoma* spp., *Mucor circinelloides* f. *circinelloides*, *Physarum*, and numerous plasmodial slime molds that did not sporulate. Many of the fungi collected from older tissues were described from decaying wood, including *Bispora betulina* (Corda 1838), *Cephalotrichum microsporum* (Saccardo 1878), *Chloridium lignicola* (Gams & Holubová-Jechová 1976), *Trichurus spiralis* (Hasselbring 1900), *Triadelphia heterospora* (Shearer & Crane 1971), and *Ulocladium atrum* (Preuss 1852). *Verticillium luteoalbum*, from cambial galleries and wounds, is a cosmopolitan fungus that has been isolated from slime fluxes and rotting wood (*e.g.* Domsch *et al.* 1980; Hughes

1951). *Humicola grisea*, typically a soil-inhabiting fungus (*e.g.* Domsch *et al.* 1980; Fassatiová 1967), was also found on discolored wood and frass.

Black yeasts were frequently isolated from decaying wood. *Aureobasidium pullulans*, a common saprobe (*e.g.* Hermanides-Nijhof 1977), was found in healthy-looking wood and was prevalent in discolored wood while *Hormonema dematioides*, similar in appearance to *Aureobasidium pullulans* var. *melanigenum*, was only found from old galleries and frass. *Phialophora verrucosa*, typically found on plant sources (Schol-Schwarz 1970; Yan *et al.* 1995) was frequently isolated in this study, although it was not one of eight *Phialophora* species identified from stained wood in other surveys (Crane *et al.* 1996; Hutchison 1999; LaFlamme & Lortie 1973). *Ramichloridium anceps*, *Rhinocladiella atrovirens*, and *Exophiala* sp. were also frequently found on discolored wood. They have previously been reported from *P. tremuloides* (Hoog, de 1977), and *R. atrovirens* and *Exophiala* sp. have been reported from beetle galleries in hardwoods and conifers (Tsuneda *et al.* 1986; Untereiner & Naveau 1999).

The more common fungal genera and species have also been reported from bark beetle galleries. These include *Acremonium, Alternaria*, *Aspergillus*, *Beauveria bassiana*, *Cladosporium*, *Fusarium solani*, *Gliocladium*, *Leptographium*, *Penicillium*, *Sporothrix*, and *Trichoderma* (Whitney 1982). Little is known about the effect of these widespread fungi, especially dry-spored hyphomycetes, on beetle biology (Harrington 1993). In a survey of microfungi from various tissues of *P. tremuloides*, Hutchison (1999) reported *Penicillium* sp. and *Valsa sordida* Nitschke from galleries characteristic of the poplar ambrosia beetle, *Trypodendron retusum* (LeC.) (Coleoptera: Scolytidae), and a *Leptographium* sp. and *Sarocladium*-like species from predatory flat bark beetle, *Laemophloeus* sp. (Coleoptera: Cucujidae), larvae. *Penicillium* and *Leptographium* species also were isolated in this study; the latter is known to be associated with insects and the former is cosmopolitan.

Many taxa identified in this study have been reported from different parts of trembling aspen, including healthy wood, healthy bark, the wood and bark of black galls and cankers, stained wood, and decayed wood. Fungi reported here and in surveys by Chapela (1989), Crane *et al.* (1996), Etheridge (1961), Hutchison (1999), and Laflamme and Lortie (1973) include: *Acremonium* sp., *Alternaria* sp., *Arthrobotrys oligospora*, *Aspergillus* sp., *Aureobasidium pullulans*, *Bispora* sp., *Cladosporium herbarum*, *Exophiala* sp., *Fusarium solani*, *Geotrichum* sp. *Leptographium* sp., *Penicillium* spp., *Phialophora* spp., *Phoma* spp., *Ramichloridium* sp., *Rhinocladiella* sp., *Sporormiella* spp., *Trichoderma* spp., and *Verticillium* sp. It is noteworthy that *Aureobasidium pullulans* (Crane *et al.* 1996) and a species of *Fusarium* (Chapela 1989) were the only fungi previously reported from healthy wood that were also isolated from pristine galleries. *Pichia membranaefaciens* and *Williopsis saturnus* were present in nearly every collection in this study, but neither was found in a survey of yeasts from trembling aspen in Alberta and northeastern British Columbia (Hutchison & Hiratsuka 1994), although *P. membranaefaciens* has been reported from *Quercus rubra* L., *Pseudotsuga menziesii* (Mirb.) Franco, and *Ulmus americana* L. (Lachance *et al.* 1982). Differences in fungal survey results are likely to be due to a specialized relationship with the beetles, distribution, and environmental conditions.

Some of the isolation results were surprising. *Geotrichum*, a filamentous endomycetous hyphomycete, was collected only once. Species of *Ascoidea*, *Dipodascus*, *Oscarbrefeldia,* and *Conidiascus* are typically isolated from slime fluxes (Batra 1987), but they were not isolated during this study. These fungi are saprophytic and non host-specific, and collections of frass and slime fluxes discussed herein appeared to be ideal habitats for such fungi. The only nematophagous genus isolated was *Arthrobotry*s, whose species have been shown to trap many genera of free-living nematodes (Oorschot, van 1985; Schenck *et al.* 1977). Absence of other nematode-destroying taxa may be due to the fact that only one nematode species was routinely isolated and low fungal diversity coincided, to an extent, with lack of nematode diversity. *Panagrellus* species typically inhabit environments undergoing fermentative changes (Hechler 1971), which may have limited the growth of other nematode-destroying fungi. Other possible limitations are lack of vectors, unsuccessful dissemination, environmental conditions, habit, and isolation techniques. Genera that are commonly regarded as coprophilous, *Ascobolus* and *Saccobolus* (Bell 1983), or have frequently been reported from dung, *Gymnoascus reessii* (*e.g.* Arx, von 1986; Domsch *et al.* 1980) and *Sporormiella cymatomera* (*e.g.* Ahmed & Cain 1972), were isolated from cambial galleries and large wounds. They most likely spread from cattle dung that was present in many of the collection areas.

The effect of poplar borer infestations on tree vigor is significant. Infested trees typically had notably less foliage, indicative of declining health. The poplar borer has been reported as a pest of living trees (Johnson & Lyon 1991), but whether poor health was the result of beetle infestation or tree health was compromised prior to infestation could not be determined. Because of the large sizes of the galleries and amount of wood excavated, it appeared that even a few infestations could dramatically contribute to tree decline and death. Infestations by the poplar and willow borer appeared to weaken tree health when infestation density was high. Trees with few infestations appeared healthy, although susceptibility to additional beetle infestations and fungal infections probably compromised vigor.

Many of the taxa identified, particularly the ophiostomatoid fungi, probably contributed to an increased rate of decay. *Fusarium* species have also been implicated in sap stain (Batra & Lichtwardt 1962; Hutchison & Reid 1996), but they have been isolated from a variety of tissues (*e.g.* Nelson *et al.* 1983) and their role in aspen trees is not known. A study by Crane *et al.* (1996) measuring the wood-degrading abilities of microfungi from *P. tremuloides* included one species, *Aureobasidium pullulans*, and four genera, *Cladosporium*, *Exophiala*, *Phialophora*, *Phoma*, that were also isolated in this study. All caused weight loss (4.50-8.20% in 6 months) and visible signs of decay, including soft rot (Crane *et al.* 1996). *Aureobasidium pullulans* caused a moderate amount of Type I soft rot (selective attack of S_2 layer of secondary wall from within wall), as defined by Corbett (1965), and the other genera caused a moderate amount of Type II soft rot (erosion of cavities and V-shaped notches in cell walls along hyphae lying in the lumen) (Corbett 1965; Crane *et al.* 1996). However, in a study by Untereiner and Malloch (1999) investigating the enzymatic degradation of carbon and nitrogen compounds of *Capronia* and allied black yeasts, including *Exophiala* spp., *Ramichloridium anceps*, and *Rhinocladiella atrovirens*, these fungi were not able to degrade chitin, cellulose, or lignin and are not believed to be saprobes of primary incidence.

Not surprisingly, taxa that are widespread and common also were isolated from *Salix* (Table 1). Direct comparisons were not made because only willow galleries from which *Ascobotryozyma* was isolated were examined; however, common or unusual fungi were noted. Fungi isolated consistently from both tree genera included *Acremonium* sp. (1), *Aureobasidium pullulans*, *Aureobasidium pullulans* var. *melanigenum*, *Fusarium solani*, *Pesotum* sp. (1), *Pesotum* sp. (2), and *Pichia membranaefaciens*, in addition to *Panagrellus dubius* nematodes. Surveys of *Salix* tissues are few, and the only taxa described from this study and in previous reports are *Aureobasidium pullulans*, *Beauveria* sp., *Fusarium* sp., *Penicillium* sp., *Phoma* sp., and *Rhizopus* (Eslyn & Lombard 1984; Petrini & Fisher 1990; Sivak & Person 1973). *Discohainesia oenotherae* was isolated once; it has been reported to be a weak pathogen causing disease symptoms on wounded hosts (Palm 1991; Sutton 1980), but its role in galleries is uncertain. It was interesting that despite the different vectors and hosts, the nematode species was the same. Perhaps characteristics of the galleries, such as microbial flora and pH, are especially suitable for *Panagrellus dubius*.

Approximately one-half of the fungi identified in this study have not, to our knowledge, been reported from trembling aspen. Many of the isolated fungi are insect-dispersed and were probably directly associated with the beetles; such an association would be advantageous because wood that has been at least partly decayed by fungi can provide a higher quality food resource for larvae (Beaver 1989). Beetles not only introduced microorganisms when the eggs were deposited into the trees, but the entrance sites also provided openings with which a variety of organisms were associated. The aromatic frass, rich with yeasts and bacteria, attracted many insects. Flies, ants, wasps, and small beetles were often observed near frass and wounds and occasionally were collected from inside galleries.

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PARMELIACEAE (ASCOMYCOTA) LICHENS IN CHINA'S MAINLAND

I. THE GENERA CANOMACULINA, PARMELINA, PARMELINELLA AND PARMELINOPSIS

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ABSTRACT: Eighteen species of parmelioid lichens belonging to the genera *Canomaculina, Parmelina, Parmelinella* and *Parmelinopsis* are recognized in China's mainland. The new combination *Canomaculina ultralucens* is made and *Parmelia kokiuensis* is synonymized with *Parmelinopsis minarum.* Six species, *Canomaculina subsumpta*, *Parmelinella chozoubae*, *Parmelinopsis afrorevoluta*, *P. microlobulata*, *P. protocetrarica* and *P. subfatiscens,* are reported as new to China. Two species, *Parmelinopsis expallida* and *P. horrescens,* are recorded in China's mainland for the first time.

KEY WORDS: *Canomaculina ultralucens*, new combination, new records

INTRODUCTION

The lichen genus *Parmelia sensu* Acharius (1803) was very heterogeneous and included a number of foliose genera including *Cetraria sens. lat.*, *Heterodermia*, *Lobaria*, *Pannaria*, *Physcia sens. lat.* as well as *Parmelia sens. lat.*, most of which are now known to belong to different families. Zahlbruckner (1926) recircumscribed the genus *Parmelia* and recognized four subgenera: *Hypogymnia*, *Menegazzia*, *Omphalodium* and *Euparmelia*. At present the so-called "parmelioid lichens" refer to taxa previously ascribed to subgenus *Euparmelia sensu* Zalhbruckner, and these have been segregated into approximately 35 genera by various authors in the past several decades (Elix 1993).

The parmelioid lichens present in Taiwan have been recently reviewed by Kurokawa and Lai (2001). The present paper is the first of a series of reports dealing with these lichens in mainland China and includes four genera: *Canomaculina*, *Parmelina, Parmelinella* and *Parmelinopsis*. These genera together with *Myelochroa* (Asahina) Hale & Elix, were segregated from *Parmelina sens. lat.* by Elix and Hale (1987).

The specimens examined are housed in HMAS-L unless stated otherwise. Most chemical constituents were identified by thin layer chromatography (Culberson 1972; Culberson *et al.* 1981; Culberson & Johnson 1982; Elix & Ernst-Russell 1993), but where necessary their identity was confirmed by high performance liquid chromatography (Feige *et al.* 1993; Elix & Wardlaw 2000) and comparison with authentic samples.

The Genus *Canomaculina*

Canomaculina Elix & Hale, *Mycotaxon* **29**: 239 (1987).
= *Rimeliella* Kurok., *Ann. Tsukuba Bot. Gard.* **10**: 1 (1991).

Species of *Canomaculina* are characterized by broad thalli with subrotund, 1-14 mm wide lobes, a pored epicortex (lacking pseudocyphellae), an effigurate-maculate upper surface, tapered and often branched cilia, the lower surface which is usually paler near margin and darker in center, the dimorphous rhizines and filiform condia. At present this genus includes *ca.* 23 species of which three occur in China.

1. Canomaculina subsumpta (Nyl.) Elix, *Mycotaxon* **65**: 476 (1997)
≡ *Parmelia subsumpta* Nyl., *Flora* **52**: 117 (1869); *Parmotrema subsumptum* (Nyl.) Hale, *Phytologia* **28**: 339 (1974); *Rimeliella subsumptum* (Nyl.) Kurok., *Ann. Tsukuba Bot. Gard.* **10**: 9 (1991).

This species is characterized by subrotund to rotund lobes (up to 10 mm wide) with distinct effigurate maculae on the upper surface, marginal and ±laminal soralia, and the presence of salazinic acid in the medulla. Kurokawa (1991) reported that this species often produces small amounts of usnic acid, but this substance is absent in Chinese and Australasian collections. This species can be considered to be the sorediate counterpart of *C. subcaperata* (Kremp.) Elix.
Canomaculina subsumpta is widespread in tropical and subtropical forests of North and South America, South-east Asia, Australia and Papua New Guinea (Elix 1994). New to China.

Specimens examined
CHINA. **Yunnan,** Fugong, *J. J. Su 1104*; Yongping, *X. Y. Wang et al. 1653-1.*

2. Canomaculina subtinctoria (Zahlbr.) Elix, *Mycotaxon* **65**: 476 (1997)
≡ *Parmelia subtinctoria* Zahlbr. in Handel-Mazzetti, *Symb. Sin.* **3**: 193 (1930); *Parmotrema subtinctorum* (Zahlbr.) Hale, *Phytologia* **28**: 339 (1974); *Rimeliella subtinctoria* (Zahlbr.) Kurok., *Ann. Tsukuba Bot. Gard.* **10**: 10 (1991). Type: CHINA.

Yunnan, Sanyinpan, north of Gunanfu, *H. Handel-Mazzetti 5645* (WU-holotype).

This species is characterized by the grey-green, membranaceous thallus, the subrotund or rotund lobes (5-14 mm wide), the dense cylindrical isidia which are ±ciliate at apices, the brownish lower surface which becomes black near centre, the dimorphous rhizines and the presence of norlobaridone, loxodin and salazinic acid in the medulla. This species should be considered to be the isidiate counterpart of *C. cristoballi* (Ferraro & Elix) Elix rather than of *C. subcaperata* as has been suggested previously (Kurokawa 1991; Elix 1994).

Canomaculina subtinctoria is widespread in temperate and tropical areas throughout the world (except for Europe) and is well known in China (Wei 1991).

Representative specimens examined

CHINA. **Guangxi**, Napo, *L. H. Chen 980357.* **Hainan**, Changjiang, *Y. M. Jiang & S. Y. Guo. 429, J. B. Chen et al. 20645.* **Sichuan**, Wolong, *X. Y. Wang et al. 9778.* **Yunnan**, Lushui, *X. Y. Wang et al. 2451, 214801;* Malipo, *J. B. Chen 5424.*

3. Canomaculina ultralucens (Krog) Elix & J.B. Chen, *comb. nov.*
Basionym: *Parmelia ultralucens* Krog, *Bryologist* **77**: 253 (1974).
= *Parmotrema ultralucens* (Krog) Hale, *Mycotaxon* **1**: 108 (1974).

This species is characterized by the loosely adnate, membranaceous thallus, the simple, laminal isidia, the jet black lower surface except for a narrow marginal zone, 2-3 mm wide, the dimorphous rhizines and the presence of salazinic acid and lichexanthone in the medulla. *Canomaculina neotropica* (Kurok.) Elix is morphologically similar but differs in having a pale brown lower surface which becomes black in the center and in lacking medullary lichexanthone. This species can be considered to be the isidiate counterpart of the sorediate species, *C. spinibarbis* (Kurok.) Elix.

Canomaculina ultralucens is a pantropical species known from Africa, North America, Australia and the Pacific (Louwhoff & Elix 1999). It has been reported previously from Jiangsu and Zhejiang provinces in China (Wei 1991, Xu 1989).

Specimen examined

CHINA. **Hainan**, Tongshi, Mt Wuzhi, *J. B. Chen, G. R. Hu & L. Xu 20593* (CANB, HMAS).

The genus *Parmelina*

Parmelina Hale, *Phytologia* **28**: 481 (1974)

Species of the genus *Parmelina sens. str.* are characterized by thalli with narrow lobes (0.5-4.0 mm wide), cilia mainly confined to the lobe axis, a pored epicortex (lacking pseudocyphellae), a ±maculate upper surface, dark brown or black lower surface, simple or very rarely squarrosely branched rhizines, cylindrical or weakly fusiform condia, and with lecanoric acid the most common medullary substance. At present the genus includes *ca.* 13 species worldwide, two of which occur in China.

1. **Parmelina gyrophorica** Elix, S. L. Wang & J. B. Chen, in Wang, Chen & Elix, *Mycotaxon* **76**: 297 (2000). Type: CHINA. Yunnan, Gongshan county, 3250 m, *J. J. Su 2539,* 25 July 1982 (HMAS-L holotype; CANB isotype).

This species is characterized by the emaculate upper surface, the sparsely ciliate lobes, the absence of soredia and isidia, the presence of sparse laminal lobules and gyrophoric acid as main medullary substance. Morphologically this species resembles *Parmelina quercina* but the latter differs in having a distinctly white-maculate upper surface and in containing lecanoric acid in the medulla. *Parmelina gyrophorica* is known only from the type locality and is endemic to China.

2. **Parmelina quercina** (Willd.) Hale, Phytologia **28**: 483 (1974)
≡ *Lichen quercinus* Willd., *Fl. Berol. Prodr.*: 353 (1787); *Parmelia quercina* (Willd.) Vain., *Természetrajzi Füz.* **22**: 279 (1899).
= *Parmelia yalungana* Zahlbr., *Hedwigia* **74**: 206 (1934).

This species is characterized by narrow lobes (1-5 mm wide), the distinct maculae on marginal lobes, the lack of soredia and isidia and the presence of lecanoric acid in the medulla. It is distinguished from *P. gyrophorica* by the presence of lecanoric acid and by the maculate upper surface.
Parmelina quercina is widely distributed in temperate regions throughout the world and is well known and widespread in China (Wei 1991).

Representative specimens examined
CHINA. **Anhui**, Mt. Huangshan, *J. D. Zhao & L. W. Wang 5403.* **Guangxi**, Longsheng, *J. B. Chen et al. 20126* (CANB). **Hubei**, Shenglongjia, *J. B. Chen 11984, 12141.* **Jiangxi**, Mt. Lushan, *J. D. Zhao 445.* **Sichuan,** Rergai, *X. Y. Wang et al. 11059.* **Shanxi**, Mt. Taibai, *C. H. Ma 225.* **Xizang**, Zhangmu, *J. C. Wei & J. B. Chen 366, 686.* **Yunnan**, Zhongdian, *X. Y. Wang et al. 7284.*

The genus *Parmelinella*

Parmelinella Elix & Hale, *Mycotaxon* **29**: 241 (1987)

Species of the genus *Parmelinella* are characterized by thalli with relatively broad lobes (3-12 mm wide), sparse cilia mainly restricted to lobe axils, the absence of maculae and pseudocyphellae, the pored epicortex, a black lower surface with a narrow, bare or papillate marginal zone, simple rhizines and bacilliform conidia. This genus, which includes five species growing on bark and rock, is distributed mainly in tropical and subtropical areas and has its centre of distribution in Southern Asia. Three species of this genus occur in China, of which *Parmelinella chozoubae* is added to the Chinese lichen flora for the first time in the present paper.

1. **Parmelinella chozoubae** (Singh & Sinha) Elix & Pooprang, *Mycotaxon* **71**: 121 (1999)
≡ *Parmelina chozoubae* Singh & Sinha, *Nordic J. Bot.* **13**: 463 (1993).

This species is characterized by the coriaceous thallus, the sublinear lobes (1-4 mm wide), the rugose upper surface, the lack of soredia and isidia, the mixture of simple and furcated rhizines, the relatively large spores, 9-17 x 5-12 µm and the presence of salazinic acid, consalazinic acid, pigmentosin A and secalonic acid A in the medulla. It closely resembles *P. simplicior* which differs in having simple rhizines and much smaller spores (5-7 x 4 µm).
Previously this species was known from India (Singh & Sinha 1993, 1994) and Thailand (Pooprang *et al.* 1999), but is new to China.

Specimen examined
CHINA. **Zhejiang**, Taishun, *Z. G. Qian & C. Ding 5622.*

2. Parmelinella simplicior (Hale) Elix & Hale, *Mycotaxon* **29**: 242 (1987)
≡ *Parmelia simplicior* Hale, *Bryologist* **75**: 99 (1972); *Parmelina simplicior* (Hale) Hale, *Phytologia* **32**: 483 (1974).

This species is characterized by the coriaceous thallus, the sublinear, emaculate lobes (3-5 mm wide) which lack soredia and isidia, the small spores (5-7 x 4 µm) and the presence of salazinic and consalazinic acids in the medulla. It resembles *P. chozoubae,* but for differences see above.
Parmelinella simplicior is known from southern India (Hale 1972) and China (Wang & Chen 2001).

Specimens examined
CHINA. **Yunnan**, Simao, *J. D. Zhao & L. W. Xu 3221;* Yingjiang, *X. Y. Wang et al. 3290.*

3. Parmelinella wallichiana (Taylor) Elix & Hale, *Mycotaxon* **29**: 242 (1987)
≡ *Parmelia wallichiana* Taylor, *Hooker J. Bot.* **6**: 176 (1847); *Parmelina wallichiana* (Taylor) Hale, *Phytologia* **32**: 483 (1974).

This species is characterized by the broad, adnate to loosely adnate thallus with broad (3-10 mm wide), irregularly branched lobes with subrotund apices, the marginal cilia especially in the axils, the subglobose to cylindrical isidia, the black lower surface with a naked or papillate dark brown zone near lobe apices, the white, ±partially yellow pigmented medulla and the presence of medullary salazinic acid, consalazinic acid, pigmentosin A and eumitrin derivatives.
Parmelinella wallichiana is common in paleotropical areas including Africa, India, Southeast Asia, Japan, Australia (Elix 1994) and is widespread in China (Wei 1991).

Representative specimens examined
CHINA. **Anhui,** Jinzhai county, *H. J. Liu 582* (CANB)*; J. D. Zhao & L. W. Xu 5144, 5188.* **Fujian**, Mt. Wuyi, *J. B. Chen & S. L. Wang 14134, 14183, 14643.* **Guangxi**, Napo, *L. H. Chen 980050;* Lingui county, *J. B. Chen et al. 20285* (CANB)*;* Longsheng County, *J. B. Chen et. al. 20031.* **Hainan**, Changjiang, *Y. M. Jiang & S. Y. Guo 392, 396.* **Hunan**, Shangzhi County, *J. B. Chen et. al. 9275, 9793;* Mt. Mangshan, *J. B. Chen et al. 20921, 20703.* **Jiangxi**, Mt. Lushan, *X. X. Hu 2081;* Yichun, *Z. G. Qian 8658-1.* **Xizang**, Zhangmu, *J. C. Wei & J. B. Chen 438-1.* **Yunnan**, Fugong county, *J. J. Su 1098, 1422;* Gongshan, *J. J. Su 2709, 2753;* Lushui county, *X. Y. Wang 2056, 2095;* Xichou, *J. B. Chen 3943, 5027.* **Zhejiang**, Mt. Tianmu, *J. D. Zhao & L. W.*

Xu 6087 (CANB); Taishun County, *Z. G. Qian & C. Ding 6621.*

The genus *Parmelinopsis*

Parmelinopsis Elix & Hale, *Mycotaxon* **29**: 242 (1987)

Species of *Parmelinopsis* are characterized by thalli with narrow (0.5-5.0 mm wide), apically acute to subtruncate lobes, relatively large spores, bacilliform conidia, simple cilia, and simple to sparingly dichotomously-branched rhizines. Related *Parmelina* has simple rhizines and smaller spores (7-14 x 5-8 µm cf. 10-20 x 7-14 µm). Chemically *Parmelinopsis* differs from the other genera of *Parmelina sens. lat.* by the preponderance of medullary orcinol tridepsides.

Parmelinopsis includes *ca.* 23 species worldwide, ten of which occur in China. Only three species, *P. cryptochlora*, *P. minarum* and *P. spumosa,* had been reported previously from mainland China (Wei 1991).

Key to species of *Parmelinopsis* in China

1. Thallus with soredia or pustules, isidia absent..2
1. Thallus with isidia, lacking pustules and soredia...6

2. Medulla K+ red, lobaric and salazinic acids present...**10. *P. swinscowii***
2. Medulla K-, lobaric and salazinic acids absent...3

3. Thallus with capitate soralia, pustules absent ....**2. *P. cryptochlora***
3. Thallus pustulate, capitate soralia absent..4

4. Medulla C-, pustules present and producing sorediate masses.........................**9. *P. subfatiscens***
4. Medulla C+ pink or red...5

5. Medulla white, pustules sorediate..**1. *P. afrorevoluta***
5. Medulla pale yellow in part, pustules ±entire, esorediate..........................**8. *P. spumosa***

6. Isidia apically ciliate ....**4. *P. horrescens***
6. Isidia not apically ciliate..7

7. Lobes narrow, 0.5-1.5 mm wide 8
7. Lobes broader, 1.0-5.0 mm 9

8. Isidia lobulate, medulla containing fatty acid ....**5. *P. microlobulata***
8. Isidia cylindrical, medulla P+ orange-red (protocetraric acid).............. **7. *P. protocetrarica***

9. Medulla C+, gyrophoric acid present..**6. *P. minarum***
9. Medulla C-, fatty acids present..**3. *P. expallida***

1. Parmelinopsis afrorevoluta (Krog & Swinsc.) Elix & Hale, *Mycotaxon* **29**: 242 (1987)

≡ *Parmelia afrorevoluta* Krog & Swinsc., *Norweg. J. Bot.* **26**: 22 (1979); *Hypotrachyna afrorevoluta* (Krog & Swinsc.) Krog & Swinsc., *Lichenologist* **19**: 420 (1987).

This species is characterized by the ascending, ±revolute lobes with dentate margins, the lack of maculae, the presence of laminal and submarginal pustular soralia, simple and

±bifurcate rhizines and the presence of gyrophoric acid (major) and the methylhiascic acid complex in the medulla (K-, C+ rose, KC+ red, P-). *Pamelinopsis afrorevoluta* resembles *Hypotrachyna revoluta* (Flörke) Hale, but the latter can be distinguished by the absence of marginal cilia and the presence of consistently dichotomously branched rhizines (rather than being simple or bifurcate). The related pustulate species, *P. subfatiscens*, *P. spumosa* and *P. swinscowii* can be distinguished from *P. afrorevoluta* by their medullary chemistry.

Parmelinopsis afrorevoluta is widespread in tropical and temperate regions of the world (Elix 1994). New to China.

Specimens examined

CHINA. **Zhejiang**, Longquan, *Z. G. Qian & C. Ding 7225-1, 7272.*

2. Parmelinopsis cryptochlora (Vain.) Elix & Hale, *Mycotaxon* **29**: 242 (1987)
≡ *Parmelia cryptochlora* Vain., *J. Bot.* **34**: 34 (1896); *Parmelina cryptochlora* (Vain.) Hale, *Phytologia* **28**: 48 (1974).

Parmelinopsis cryptochlora is characterized by the narrow (0.5-2.0 mm wide) and often ascending lobes, the subapical, capitate soralia, and the presence of gyrophoric acid (major) and the hiascic acid complex in the medulla (K-, C+ rose, KC+ red, P-). This species can be distinguished from *P. afrorevoluta* by the narrower lobes (0.5-2.0 mm cf. 2-5 mm wide) and the capitate soralia (rather than pustular soralia).

At present *P. cryptochlora* is known from the Carribean, India (Hale 1976), Australia (Elix 2002) and Papua New Guinea (Louwhoff & Elix 2002) and from Zhejiang in China (Xu 1989).

Specimen examined

CHINA. **Zhejiang**, Longquan, *Z. G. Qian & C. Ding 7225.*

3. Parmelinopsis expallida (Kurok.) Elix & Hale, *Mycotaxon* **29**: 242 (1987)
≡ *Parmelia expallida* Kurok. *Bull. Natl. Sci. Mus. Tokyo* **11**: 191 (1968); *Parmelina expallida* (Kurok.) Hale, *Phytologia* **32**: 482 (1974).

This species is characterized by the sublinear lobes (2-4 mm wide), dense, cylindrical isidia on the upper surface, the brown lower surface, and the fatty acids, protolichesterinic, lichesterinic, nephrosterinic and isonephrosterinic acids in the medulla (K-, C-, KC-, P-).

Parmelinopsis expallida is a relatively rare Asian species known from India, Thailand, Taiwan and the Philippines (Elix *et al.* 2002, Kurokawa & Lai 2001; Hale 1976), which has not previously been reported from China's mainland.

Specimens examined

CHINA. **Hunan**, Mt. Mangshan, *J. B. Chen et al. 20977.* **Yunnan**, Malipo, *J. B. Chen 5432;* Gongshan, *J. J. Su 3126-1, 3244.*

4. Parmelinopsis horrescens (Taylor) Elix & Hale, *Mycotaxon* **29**: 242 (1987)
≡ *Parmelia horrescens* Taylor in J. T. Mackay, *Fl. Hibern.* **2**: 144 (1836); *Parmelina*

horrescens (Taylor) Hale, *Phytologia* **28**: 482 (1974); *Hypotrachyna horrescens* (Taylor) Krog & Swinsc., *Lichenologist* **19**: 420 (1987).
=*Parmelia dissecta* Nyl., *Flora* **65**: 451 (1882); *Parmelina dissecta* (Nyl.) Hale, *Phytologia* **28**: 482 (1974).

This species is characterized by the narrow (0.5-2.5mm wide), linear to sublinear lobes, the cylindrical and/or coralloid-lobulate isidia which become ciliate at apices, the black lower surface with a narrow, brown, erhizinate marginal zone, and the presence of 3-methoxy-2,4-di-*O*-methylgyrophoric and 2,4-di-*O*-methylgyrophoric acids as major lichen substances (K-, C-, KC+ red, P-). *Parmelinopsis horrescens* resembles the other isidiate species, *P. expallida* and *P. minarum*, but in *P. horrescens* the isidia are typically coralloid-lobulate and apically ciliate whereas the isidia are cylindrical and ±branched, in the other two species. These three species also differ chemically.
Parmelinopsis horrescens is a pantemperate and montane pantropical species (Elix 1994, Hale 1976) and has been reported previously from Taiwan (Kurokawa & Lai 2001, Hale 1976). New to mainland China.

Representative specimens examined
CHINA. **Guangxi**. Wuming, *J. B. Chen et. al. 20427, 20429.* **Hunan**, Mt. Mangshan, *J. B. Chen et al. 21042.* **Zhejiang**, Taishun, *Z. G. Qian & C. Ding 5739.*

5. Parmelinopsis microlobulata (Awas.) Elix & Hale, *Mycotaxon* **29**: 242 (1987)
≡ *Parmelia microlobulata* Awas., *Biological Memoirs* **1**: 182 (1976) 1977.

Parmelinopsis microlobulata is characterized by very narrow lobes (0.3-1.5 mm wide), the presence of isidia and dense, ±imbricate lobules, the black lower surface and the negative medullary reactions (K-, C-, KC-, P-, the fatty acids, myelochroic, neuropologic, isomyelochroic and protoneuropologic acids).
This species was previously known from the East Himalayas in India (Awasthi 1977) and Thailand (Pooprang *et al.* 1999). New to China.

Specimen examined
CHINA. **Guangxi**, Longsheng, *J. B. Chen et al. 20077.*

6. Parmelinopsis minarum (Vain.) Elix & Hale, *Mycotaxon* **29**: 243(1987)
≡ *Parmelia minarum* Vain., *Acta Soc. Fauna Fl. Fenn.* **7**: 48 (1890); *Parmelina minarum* (Vain.) Skorepa, *Phytologia* **53**: 445 (1983); *Hypotrachyna minarum* (Vain.) Krog & Swinsc., *Lichenologist* **19**: 420 (1987).
= *Hypotrachyna kokiuensis* (Zhao, Hsu & Sun) Wei, *An Enumeration of Lichens in China:* 119 (1991); *Parmelia kokiuensis* Zhao, Hsu & Sun, *Acta Phytotax. Sin.* **16**: 95 (1978). Type: CHINA. Yunnan, Gejiu, *J.D. Zhao & Y.B. Chen 2344,* 10 Nov. 1960 (HMAS-L).

This species is characterized by the narrow lobes (1-3 mm wide), the dense cylindrical isidia, and by the medullary gyrophoric and 5-*O*-methylhiascic acids (K-, C+ pale red, KC+ red, P-. It can be distinguished from *P. horrescens* and *P. microlobulata* by the nature of the isidia and the medullary chemistry. Kuokawa identified the type of *P.*

kokiuensis as *Parmelia dissecta auct. non.* Nyl. (= *P. minarum*) during a visit to Beijing in 1987, and this has been confirmed by our morphological and chemical studies.
Parmelinopsis minarum is a cosmopolitan species which, in China, has been reported from Anhui and Zhejiang by Wu and Qian (Xu 1989) and Taiwan (Kurokawa & Lai 2001, Hale 1976).

Representative specimens examined
CHINA. **Fujian**, Mt. Wuyishan, *J. B. Chen & S. L. Wang 14051, 14061.* **Guangxi**, Wuming, *J. B. Chen et al. 20352, 20388-1.* **Hunan,** Zhangjiajie, *J. B. Chen et al. 8971, 9173;* Shangzhi, *J. B. Chen et al. 9774, 10020.* **Jiangxi,** Mt. Lushan, *C. Ding 8319, 8340.* **Yunnan**, Xichou, *J. B. Chen 5019.* **Zhejiang**, Taishun, *Z. G. Qian & C. Ding 6461-1.*

7. Parmelinopsis protocetrarica Elix, *Mycotaxon* **47**: 119 (1993).

Parmelinopsis protocetrarica is characterized by the fragile, diminutive thalli with narrow lobes (0.8-1.2 mm wide), the cylindrical isidia, the pale brown lower surface, and by the protocetraric and gyrophoric acids in the medulla (medulla K-, C+ rose, KC+ red, P+ orange-red). Morphologically, it could be confused with *P. expallida* since this species also bears isidia and has a pale lower surface, but in *P. protocetrarica* the isidia become procumbent, flattened and sublobulate (cylindrical and coralloid-branched in *P. expallida*), and these species differ in medullary chemistry.
This rare species was previously known only from Australia (Elix 1994) and Papua New Guinea (Louwhoff & Elix 2002). New to China.

Specimen examined
CHINA. **Hainan**, Mt. Wuzhishan, *J. B. Chen et al. 20614.*

8. Parmelinopsis spumosa (Asahina) Elix & Hale, *Mycotaxon* **29**: 243 (1987)
≡ *Parmelia spumosa* Asahina, *J. Jap. Bot.* **26**: 159 (1951); *Parmelina spumosa* (Asahina) Hale, *Phytologia* **28**: 483 (1974); *Hypotrachyna spumosa* (Asahina) Krog & Swinsc., *Lichenologist* **19**: 420 (1987).

This species is characterized by the adnate, fragile thallus, the narrow lobes (0.5-2mm wide), the esorediate pustules (dactyls), the white medulla which is pale yellow in part, and the presence of gyrophoric and 5-*O*-methylhiascic acids (medulla K-, C+ rose, KC+ red, P-). Chemically, *P. spumosa* is similar to *P. afrorevoluta* and *P. minarum*, but *P. afrorevoluta* has sorediate pustules and *P. minarum* has cylindrical isidia, whereas *P. spumosa* has pustular dactyls which do not or only sparingly become sorediate.
Parmelinopsis spumosa is a widespread pantropical species (Elix 1994, Hale 1976) and has been reported previously from China (Wei 1991).

Specimens examined
CHINA. **Guangxi,** Wuming, *J. B. Chen et al. 20394.* **Hainan,** Tongshi, Mt. Wuzhishan, *J. B. Chen et al. 20635-2.*

9. Parmelinopsis subfatiscens (Kurok.) Elix & Hale, *Mycotaxon* **29**: 243 (1987)
≡ *Parmelia subfatiscens* Kurok., in M. E. Hale & S. Kurokawa, *Contr. U.S. Natl. Herb.*

36: 134 (1964); *Parmelina subfatiscens* (Kurok.) Hale, *Phytologia* **28**: 483 (1974); *Hypotrachyna subfatiscens* (Kurok.) Krog & Swinsc., *Macrolichens of East Africa*: 122 (1988).

This species is characterized by the crowded, imbricate, narrow lobes (0.5-2.5 mm wide), the subapical to laminal pustules (these pustules may be entire and/or produce coarse, sorediate masses), and the presence of 3-methoxy-2,4-di-*O*-methylgyrophoric and 2,4-di-*O*-methylgyrophoric acids as major medullary substances (K-, C-, KC+ rose, P-). *Parmelinopsis horrescens* has similar chemistry, but can be separated by the ciliate, often lobulate coralloid-isidia, rather than sorediate pustulate.
This species has been recorded from East and South Africa, the Caribbean region, South America, Australia, New Zealand and Papua New Guinea (Elix 1994, Hale 1976, Louwhoff & Elix 2002). New to China.

Specimens examined
CHINA. **Hainan**, Tongshi, Mt. Wuzhishan, *J. B. Chen et al. 20635.* **Hunan**, Zhangjiajie, *J. B. Chen et al. 9277;* Mt. Mangshan, *J. B. Chen et al. 20882, 20901, 20913, 20935-1.* **Zhejiang**, Taishun, *Z. G. Qian & C. Ding 6877.*

10. Parmelinopsis swinscowii (Hale) Elix & Hale, *Mycotaxon* **29**: 243 (1987)
≡ *Parmelia swinscowii* Hale, *Phytologia* **27**: 4 (1973); *Parmelina swinscowii* (Hale) Hale, *Phytologia* **32**: 483 (1974); *Hypotrachyna swinscowii* (Hale) Krog & Swinsc., *Lichenologist* **19**: 420 (1987).

Parmelinopsis swinscowii is characterized by the loosely attached, pale to dark grey thallus, the narrow (1-2 mm wide), sublinear lobes with a plane to rugose upper surface, the submarginal to subapical, pustulate soredia and the presence of salazinic and lobaric acids in the medulla (K+ yellow then red, C-, KC+, P+ orange-red). This species can be readily distinguished from other sorediate species present in China by the medullary reactions.
Parmelinopsis swinscowii is known from East Africa, Central and South America (Swinscow & Krog 1988), New Zealand and from China (Wang & Chen 2001).

Specimen examined
CHINA. **Yunnan**, Lushui, *X. Y. Wang, X. Xiao, J. J. Su 2633.*

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GRAPHINA STREBLOCARPA, GRAPHINA SUBSERPENTINA (GRAPHIDACEAE, LICHENISED ASCOMYCOTA) AND THEIR SYNONYMS

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Abstract

Graphina fissofurcata, *G. hiascens* var. *clausior* and *G. tjibodensis* are reported as synonyms of *Graphina streblocarpa*. *Graphina adtenuans*, *G. insulana*, *G. macgregorii*, *G. nylanderi*, *G. orientalis*, *G. palmicola* and *G. subtartarea* are reported as synonyms of *G. subserpentina*. *G. subserpentina* is reported for the first time from the Solomon Islands.

Introduction

Several morphologically similar species of *Graphina* have been described which share the following characteristics, viz: corticolous habitat, large muriform ascospores and laterally carbonised proper excipies. These species fall into two groups, one containing stictic acid and the other norstictic acid. The earliest name for the species containing stictic acid is *G. streblocarpa* (Bél.) Müll. Arg. while the earliest name for the species with norstictic acid is *G. subserpentina* (Nyl.) Müll. Arg. These acids were unknown to earlier lichenologists and as a consequence the morphological similarity of the species has led to some misidentifications. The reports of *G. streblocarpa* in Amboina [Ambon] (Krempelhuber 1871) and in Samoa (Zahlbruckner 1908) are incorrect as a recent examination of the relevant specimens from W showed them to contain norstictic acid and are thus identical with *G. subserpentina*. However, Zahlbruckner's report of *G. streblocarpa* from German East Africa [Tanzania] (Zahlbruckner 1926) is correct. Redinger was aware of the similarity of the two species and reduced *G. subserpentina* to a variety of *G. streblocarpa* (Redinger 1936: 84). There are, however, other differences between the taxa, in addition to the chemical differences, which suggest that the two taxa should be maintained at the species level. *Graphina subserpentina* is predominantly, but not exclusively, a coastal species, whereas G. *streblocarpa* occurs at higher altitudes and is an inland species. In addition, *G. streblocarpa* is saxicolous (as well as corticolous) in India (Patwardhan & Nagarkar 1979) and Australia (Archer 2001) whereas *G. subserpentina* is exclusively corticolous.

Graphina streblocarpa

In 1834 the French botanist Charles Bélanger (1805-1881) published a botanical account of his voyage to India, Mauritius, South Africa and Saint Helena (Bélanger 1834). His account was published in several parts and at different dates. Among the lichens that he collected was the new species *Opegrapha streblocarpa* (Bélanger 1834: 134) which was published on May 24th. 1834 (Ross 1964). No details of the ascospores were given but Nylander (1866) and Krempelhuber (1871) described them as being hyaline and muriform and as a consequence the species was later transferred to the genus *Graphina* (Müller 1882). A recent examination of the holotype from Geneva found it to be identical with the widely distributed species *Graphina fissofurcata* (Leight.) Müll. Arg.

SYNONYMY

Graphina streblocarpa (Bél.) Müll. Arg., *Flora* **65**: 502 (1882)
Opegrapha streblocarpa Bél., Voy. .Indies. *Or., Botanique II, Cryptogamie*: 134 (1834)
Graphis streblocarpa (Bél.) Nyl., *Flora* **49**: 133 (1866)
Phaeographina streblocarpa (Bél.) Overeem, *Bull. Jard. Bot. Buitenzorg ser. III*, **4**: 117 (1922)
Type: INDIA. Sur l'écorce des bois morts, dans les forêts du Bengale, *C. Bélanger s.n.*, no date; lectotype here designated: G.

Graphina fissofurcata (Leight.) Müll. Arg., *Flora* **65**: 385 (1882)
Graphis fissofurcata Leight., *Trans. Linn. Soc. London, Bot.* **27**: 177 (1869)
Type :CEYLON [SRI LANKA]. Nuwara Eliya, 6000 ft. *G.H.K. Thwaites C.L. 75*; lectotype: BM.
Graphis hiascens (Fée) Müll. Arg. var. *clausior* Vain., *Ann. Acad. Sci. Fenn.*, ser. A, 15, **6**: 204 (1920).
Type: THE PHILIPPINES. Luzon, Rizal, Antipolo, *M. Ramos & G. Edaño*, July 1917, Bureau of Science no. 29548;holotype: TUR-V 27227.
Graphina tjibodensis Zahlbr., *Ann. Cryptog. Exot.* **1**: 137 (1928).
Type: JAVA [INDONESIA]. Tjibodas, 1500 m, *C. van Overeem 100*; holotype: W.

Additional specimen examined :
TANZANIA [German East Africa], East Usambara, on tree trunks in rain-forest, *Brunntahler, s.n.*, 28.vii.1909 (W).

Discussion

Bélanger described his new species as follows: "this species consists of a crusty, thick, uneven, subverrucose thallus with a clear fawn colour and an ill-defined margin. The narrow, elongated, sometimes curved, always very sinuous, lirellae are branched and rarely simple, with a prominent, thick, undulant thalline margin; the disc is black and marked by a slit; the interior is hard and close textured".

In modern terms, the species is characterised by lirellae with a conspicuous thalline margin, a laterally carbonised proper exciple, muriform, hyaline ascospores and the presence of stictic acid.

Nylander transferred *O. streblocarpa* to *Graphis* (Nylander 1866) and recorded a specimen from Bogor, Indonesia where the species was reported to be common. Massalongo (posthumously published in Krempelhuber 1871) transferred *Opegrapha streblocarpa* to his new genus *Leiorreuma* (*sic*) [a misprint for *Leiogramma* (cf. Redinger 1936: 84)], also based on a specimen, from Indonesia, but collected by Doleschall. Krempelhuber also reported that two additional species (in the same genus) named by Massalongo, viz: *L. canariorum* and *L. amboinense*, were identical to *L. streblocarpum*. However, a recent examination of the specimens referred to by Krempelhuber has found them to be *G. subserpentina (vide infra)*. In a list of cryptogams collected in the Dutch East Indies, Overeem (1922) transferred this species to *Phaeographina*, an unnecessary change as the ascospores are hyaline. Overeem's list also contains *Graphis streblocarpa* (Bél.) Mont. & Bosch but no description was given of either taxon. *Graphina. hiascens* var. *clausior*, which Vainio described from the Philippines, was reported by Wirth & Hale (1963) to differ from *G. hiascens* by containing stictic acid, in contrast to *G. hiascens* which contains norstictic acid. Subsequent examination of the holotype showed it to be identical to *G. fissofurcata* (Archer 2001).

Zahlbruckner (1928, *loc. cit.*) described *G. tjibodensis* as a new species from Indonesia; the holotype was also found to be identical to that of *G. fissofurcata* (Archer 2001). Redinger (1936), in his key to taxa published from Indonesia, differentiated *G. streblocarpa* and *G. tjibodensis* by the width of the ascospores.

The type specimen of *Graphina streblocarpa* in Geneva was reported to contain stictic acid (K.P. Singh, 1989, *in sched.*); the specimen was also labelled as "isolectotype". Bélanger's specimens were acquired by Delessert (Stafleu & Cowan 1976: 168) and deposited in G; in the absence of any other Bélanger specimens the specimen in G is here designated as the lectotype.

Graphina streblocarpa is known from Australia, India, Indonesia (as *G. fissofurcata*) (Archer 2001), East Africa (Zahlbruckner 1926), Papua New Guinea (Aptroot *et al.* 1995) and Thailand (as *G. fissofurcata*) (J. Sutjaritturakan 2001, *in litt.*).

Graphina subserpentina

Seven species of *Graphina* have been described which share the following characteristics, viz: corticolous habitat, large muriform ascospores, laterally carbonised proper exciples and the presence of norstictic acid as the major lichen compound. The earliest name among them is *Graphina subserpentina* (Nyl.) Müll. Arg., based on *Graphis subserpentina* Nyl. The remaining six species are here reduced to synonymy.

SYNONYMY

Graphina subserpentina (Nyl.) Müll. Arg., *Bull. Bot. Soc.Belgique* **32**: 152 (1893).
Graphis subserpentina Nyl.:, *Acta Soc. Sci. Fenn.* 7: 465 (1863).
Type: CEYLON [Sri Lanka], *H. Hooker NH 8012*; holotype: G (*fide* Nakanishi *et al.* 2001).

Graphina insulana Müll. Arg., *Bot. Jahrb*. **4**: 56 (1883).
Type: FIJI, Viti Leva [Levu], no collector, 30.xi.1875;holotype: G.
Graphina adtenuans (Nyl.) Zahlbr., *Cat. Lich. Univ*. **2**: 395 (1923).
Graphis adtenuans Nyl., *J. Linn. Soc. London, Bot.* **20**: 57 (1883).
Type: Straits Settlements [MALAYSIA]. Malacca [Melaka], St. Johns Hill, *A.C. Maingay s.n*., 1868; holotype: H-NYL 8018.
Graphina subtartarea Müll. Arg., *Flora* **70**: 402 (1887).
Type: AUSTRALIA. Queensland, Trinity Bay [Cairns], *W.A. Sayer s.n.;* holotype: G.
Graphina palmicola Müll. Arg., *Flora* **70**: 402 (1887).
Type: AUSTRALIA. Queensland, Trinity Bay [Cairns], *W.A. Sayer s.n*.; holotype: G; isotype: MEL 515674.
Graphina orientalis (Vain.) Zahlbr., *Cat. Lich. Univ*. **2**: 416 (1923).
Graphis orientalis Vain., *Ann. Acad. Sci. Fenn. Ser. A*, **6**: 206 (1921).
Type: THE PHILIPPINES. Biliran, *R.C. McGregor,* June 1914, Bureau of Science no. 184545; syntype: TUR-V 27230.
Graphina macgregorii (Vain.) Zahlbr.,*Cat. Lich. Univ*. **2**: 413 (1923).
Graphis macgregorii Vain., *Ann. Acad. Sci. Fenn. Ser. A*, **6**: 207 (1921).
Type: MARIANAS ISLANDS. Guam, *R.C. Macgregor 607*, October 1911; holotype: TUR-V 27242.
Graphina nylanderi Patwardhan & Kulkarni, *Norw. J. Bot.* **26**(1): 47 (1979).
Type: INDIA. Karnataka-South Canara, Agumbe 74.3053, *leg. P.G. Patwardhan & M.B.Nagarkar*; holotype: AMH.

Additional specimens examined :
AUSTRALIA. Northern Territory: Channell Point, 23 km NW of Daly River, *J.A. Elix 27704*, July 1991 (CANB).
Queensland: Mt. Archer Environmental Park, 7 km NE of Rockhampton , *J.A. Elix 34543,* Aug 1993 (CANB); Proserpine River valley, 20 km WNW of Proserpine, *J.A. Elix* 21113, July 1986 (CANB).
FIJI. Viti Levu: on coconut palm, *F.R.M. Wilson s.n.,* Aug. 1893 (NSW 426692).
SOLOMON ISLANDS. Guadalcanal Island: NW end, north coast, ca. 40 km along coast road W of Honiara, *D.J. Hill 1023, 10038*, July 1965 (BM); *ibid*., ca. 32 km along coast road W of Honiara, *D.J. Hill 10016*, July 1965 (BM); central part, N coast, ca. 15 km along road to Henderson airfield, *D.J. Hill 10067*, July 1965 (BM).
INDONESIA. Amboina [Ambon] *Doleschall, s.n*., 1857 (W).
SAMOA. Upolu, on *Cocos nucifera*, *K. & L. Rechinger 2860*, 1905 (W).
CAROLINE ISLANDS. Palau Island, on *Cocos nucifera*, *A.W. Herre s.n.,* (W).
TONGA. Tongalabu, [Tongatapu] *Graeffe s.n.,* (W).

Discussion

Graphina subserpentina (Nyl.) Müll. Arg., *G. orientalis* (Vain.) Zahlbr. and *G. macgregorii* (Vain.) Zahlbr. were reported as synonyms of *G. hiascens* (Fée) Müll. Arg. (Wirth & Hale 1963). However, *G. hiascens* has short, simple lirellae ["vulgo duplo longiores quam latae" (Müller 1887); 0.5-2 mm long and about 0.5 mm wide (Wirth & Hale, loc. cit.)] which resemble those of *Graphina lumbschii* A.W. Archer (Archer 2001: 174, Fig. 30). In contrast, the lirellae of *G. subserpentina, G. orientalis* and *G. macgregorii* are much longer and up to 9 mm long in *G. orientalis* (Vainio 1921: 206). These three species are thus distinct from *G. hiascens*.

Redinger (1936), and later Nakanishi (2001), reported *G. insulana* Müll. Arg. as a synonym of *G. subserpentina*.

Nylander compared his species *Graphis adtenuans* with *Graphis subserpentina* (Nylander & Crombie 1883) and subsequently Nakanishi reported the presence of norstictic acid in *G. adtenuans* and labelled the specimen *Graphina subserpentina* (Nakanishi 1973, *in sched.*)

A re-examination of *G. palmicola* Müll. Arg. and *G. subtartarea* Müll. Arg. has shown them to be synonymous with *G. subserpentina*. Although the lirellae of *G. palmicola* were reported to be larger and more conspicuous than those of *G. subtartarea* (Archer 1999), after examination of additional specimens from Queensland and the Solomon Islands the two species were found to be indistinguishable. As a consequence the two species are here reduced to synonymy with *G. subserpentina*. The holotype of both species were collected by the same collector at the same locality i.e. Trinity Bay (Cairns, Queensland).

Graphina subserpentina was reported from India by Patwardhan and Kulkarni (1976) and later the same authors described the new species, *G. nylanderi* (Patwardhan & Kulkarni 1979). This species was distinguished from *G. subserpentina* by the degree of immersion and branching of the lirellae. These minor morphological variations are not considered to be sufficient to maintain *G. nylanderi* as a separate species and it is here reduced to synonymy with *G. subserpentina*.

Graphina subserpentina occurs in India, Sri Lanka, Thailand, Malaysia, Hawaii (as *Graphina adtenuans*) (Magnusson 1955), the Philippines, Indonesia, Fiji, the Solomon Islands, Australia and possibly Brazil (Krempelhuber 1876) although Krempelhuber was not definite in his determination.
The species is illustrated by Nakanishi *et al.* (*2001,* Fig. 2c.).

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ANNOTATED LIST OF NON-POROID APHYLLOPHORALES OF BELARUS

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Abstract: A cumulative list of 281 species known from Belarus, with non-poroid hymenophores and belonging to the order Aphyllophorales, is presented. Data based on literature sources (since 1889) and on examined herbarium material (mostly MSK fungal collections, 1924, 1950–2002) are included. Each species is accompanied by brief information on nomenclature, about when it was first reported from Belarus, about distribution in physiographic regions of Belarus, pattern of nutrition and, in some cases, by remarks on morphology. Thirty-seven species are reported for the first time from Belarus. Based on the study of the holotype of *Athelia subtessulata* var. *efibulata*, this taxon is synonymized with *Phanerochaete avellanea*.

Keywords: aphyllophoroid fungi, distribution, nomenclature, taxonomy

Introduction

Definition of non-poroid taxa. This paper deals with fungi included in the order *Aphyllophorales* Rea following Donk (1964). The list includes all homobasidiomycetes which lack a regularly forming, typical pore-like hymenophore, but which sometimes have reticulate, folded or veined, *Irpex*-like or false-lamellate hymenophores (as in *Meruliopsis*, *Cantharellus*, *Irpex* and *Schizophyllum* respectively), or false, "cyphelloid" pores (as in *Porotheleum*). The "cyphelloid" genus *Merismodes* now classified in the Cortinariales, the "agaricoid" genus *Lentinellus* now classified in the Hericiales, and the lamellate genus *Plicaturopsis* now thought to have affinity with *Schizophyllum* (Hawksworth *et al.*, 1995) are also included. Thus all polyporoid fungi *sensu lato* are excluded. The genus *Tulasnella* having an intermediate position between homo- and heterobasidiomycetes was however included because of the typically corticioid macroscopic shape of its basidiomata.

This work is the first cumulative list of this group of fungi recorded from Belarus since 1889, with geographical distribution data for species and information on synonyms used by investigators in Belarus.

Collections studied. The basis of this study is collections from the V.F. Kuprevich Institute of Experimental Botany Herbarium, section “Fungi” (**MSK–F**), critically revised by the author. The main collectors contributing material of these fungi to that herbarium are E.O. Yurchenko, E.P. Komarova and A.I. Golovko (Klimovich). Information on specimens from other collectors is also included in the present list. Among these, earlier collectors include G.I. Serzhanina, O.S. Gapienko, I.I. Zmitrovich, V.S. Komarov, V.P. Savich (Savicz), N.A. Novikov, N.V. Gorbach (Semenova) and Z.V. Zakharova, and more recent collectors include N.G. Kordiyako, D.I. Tret’yakov, D.B. Belomesyatseva, Ye.N. Rotkina, M.P. Mlynarchik, A.I. Rubchenya, A.N. Skuratovich and V.A. Metelitsa. Several specimens from the V.L. Komarov Botanical Institute Herbarium (St. Petersburg, **LE**) collected in Belarus were also studied.

Format of the list. Each species entry contains the following sequence of data separated by the markers “/” or “–”:

Latin name and place of publication. – Synonym(s) under which the species was published in literature on fungi of Belarus or synonym(s) used on MSK herbarium labels, sometimes also other widely used names (e.g. *Macrotyphula juncea* for *Clavariadelphus junceus*); names having different basionyms being separated by “;”. – Anamorph name / number of herbarium specimens studied by the author (or the reference herbarium number if only one specimen was studied) / the earliest date of collection for the specimens studied / the first bibliographic source where the species was reported for Belarus / distribution in natural (physiographic) districts of Belarus / type of nutrition.

New species for Belarus are marked by an asterisk (*****) before the name. Specimens under the same MSK number, but with different suffix letters (a, b, etc.) were assessed separately. For checking nomenclature CORTBASE Vers. 1.4 (Parmasto, 1997) was used for corticioid taxa, the monograph by Kõljalg (1996) for tomentelloid fungi and key-book “Nordic macromycetes” (Hansen & Knudsen, 1997) for other taxa. The author has added to these a series of corrections and additions. Pre-Friesian names are listed through the sanctioning author’s citation, except for *Athelia epiphylla* and *Corticium roseum*, where only the species epithet was sanctioned.

For mode of fungus nutrition the following acronyms were used: **S** – saprobic (on wood, litter, herbs, mosses, other fungi, humus and occasionally mineral substrata – sand, clay), **E** – ectomycorrhizal and **P** – parasitic (on woody plants, herbs, bark-inhabiting mosses, lichens and algae). When nutrition type based on observations in Belarus was unclear, the following acronyms were used: **W** – in trunk wounds and cankers, **RD** – on recently dead wood and bark, **B** – on bark of living trunks (including bark near ground-level) and living branches, **LM** – probably epiphytic on living and dying parts of mosses and liverworts, **LF** – probably non-parasitic on another living fungal organisms, including lichens, **(S)** – on soil, possibly ectomycorrhizal.

For the description of species distribution we used numbered physiographic districts following Dzyaments'eu (1975; fig. 1), and the following conventions: normal type, e.g. ‘20’ – record(s) from a district confirmed by herbarium specimens (MSK, LE); italic, e.g. ‘*20*’ – probable locations of record from the border of two districts or having insufficient information about exact geographic location; with asterisk, e.g. ‘20*’ and ‘*20**’ – a record known from literature only. Literature sources with data on fungi found in Verkhne-

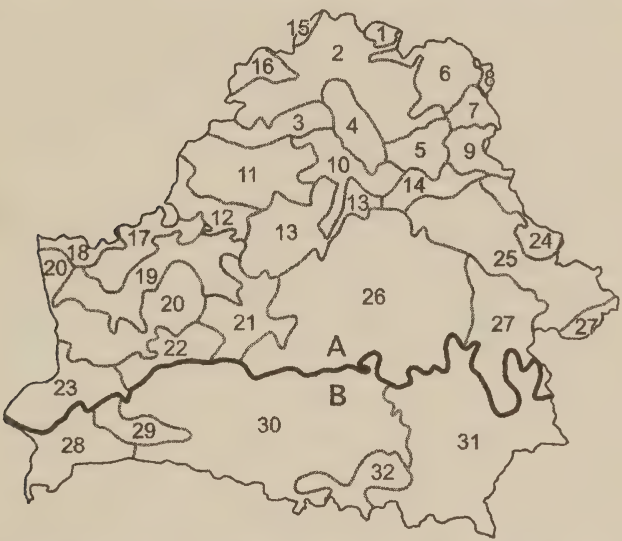

Fig. 1. Physiographic divisions of Belarus. A – boreo-nemoral subzone, B – nemoral (sub)zone. Districts: 1 – Neshchardauskae (Neshcharda) Elevation, 2 – Polatskaya (Polatsk) Lowland, 3 – Svyantsyanskiya (Svyantsyany) Moraine Ridges, 4 – Ushatska-Lepel'skae (Ushachy-Lepel') Elevation, 5 – Chashnitskaya (Chashniki) Plain, 6 – Nevel'ska-Haradotskae (Nevel-Haradok) Elevation, 7 – Vitsebskae (Vitsebsk) Elevation, 8 – Surazhskaya (Surazh) Lowland, 9 – Lowland of Luchosa, 10 – Verkhnebyarezinskaya (Upper Byarezina) Lowland, 11 – Narachana-Vileiskaya (Narach-Vileika) Lowland, 12 – Ashmyanskae (Ashmyany) Elevation, 13 – Minskae (Minsk) Elevation, 14 – Arshanskae (Orsha) Elevation, 15 – Lathal'skae Elevation, 16 – Braslauskae (Braslau) Elevation, 17 – Lidskaya (Lida) Plain, 18 – Syarednenyomanskaya (Middle Nyoman) Lowland, 19 – Verkhnyanyomanskaya (Upper Nyoman) Lowland, 20 – Southwest branch of Belarusian Moraine Ridge, 21 – Kapyl'skaya (Kapyl') Moraine Ridge and adjacent plains, 22 – Baranavitskaya (Baranavichy) Plain, 23 – Prybuhskaya (Near-Buh) Plain, 24 – Horatska-Mstsislauskaya (Horki-Mstsislau) Plain, 25 – Arshanska-Mahilyouskaya (Orsha-Mahilyou) Plain, 26 – Tsentral'nabyarezinskaya (Central Byarezina) Plain, 27 – Chachorskaya (Chachora) Plain, 28 – Brestskae (Brest) Palesse, 29 – Zaharoddze, 30 – Prypyatskae (Prypyats`) Palesse, 31 – Homel`skae (Homel') Palesse, 32 – Mazyrskae (Mazyr) Palesse.

Dneprovskii (Upper Dnieper) floristic district (see Nikolajeva, 1961; fig. 2) or indicating the fungus spreading "commonly over the forest zone of East Europe" and so containing non-precise information about species finds in Belarus are given in italics: e.g. *Davydkina (1980)*. It should be noted that the information in Nikolajeva (1961) is accompanied by very approximate maps of distribution. In such cases the "valid" report of the species for Belarus is the source added on the second place in the line.

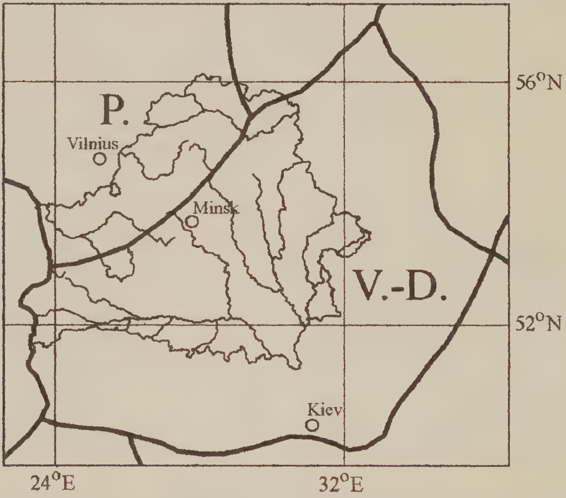

Fig. 2. Comparison of the Republic of Belarus and Verkhne-Dneprovskii (Upper Dnieper, **V.-D.**) floristic district boundaries. **P.** – Pribaltiiskii (Near-Baltic) floristic district.

List of species

1. **Acanthophysellum cerussatum** (Bres.) Wu, Boidin & Chien, Mycotaxon 76: 160, 2000. – *Aleurodiscus cerussatus* (Bres.) Höhn. & Litsch. / 4 / 30 Jun 1997 / Yurchenko (2000d) / *19*, 30, 32 / S.

In MSK 5505 well-pronounced acanthohyphidia are absent, but hyphidia with dendroid apices are present. Other specimens have atypically small spores, 6.3–8.5 × 3.5–5 µm.

2. **Amaurodon viridis** (Alb. & Schwein. : Fr.) J. Schröt. in Cohn, Krypt.-Fl. Schles. 3 (1): 461, 1888 /// Kõljalg (1996) / *23** / S.

3. **Amphinema byssoides** (Pers. : Fr.) J. Erikss., Symb. Bot. Upsal. 16 (1): 113, 1958 / 54 / 16 Aug 1956 / Komarova (1966) / 2, 10, *12*, 13, 21, 26, 30 / S, E, B, LM, LF.

4. **Amylocorticium subincarnatum** (Peck) Pouzar, Česká Mykol. 13 (1): 11, 1959 / MSK 3993 / Oct 1969 / Komarova (1966) / 10, 23* / S.

5. **Amylostereum areolatum** (Chaillet ex Fr. : Fr.) Boidin, Rev. Mycol. (Paris) 23: 345 (1959) / 2 / 11 Jul 1998 / *Davydkina (1980)*, Golovko (1988) / *3**, 10, *13** / S, LM.

6. **Amylostereum chailletii** (Pers. : Fr.) Boidin, Rev. Mycol. (Paris) 23: 345, 1959 / 2 / 21 Oct 1964 / Komarova (1966) / 10, 14, 30* / S.

7. **Amylostereum laevigatum** (Fr. : Fr.) Boidin, Rev. Mycol. (Paris) 23: 345, 1959 / 2 / 28 Jun 1997 / *Davydkina (1980)*, Yurchenko (2000a) / 10, 23 / S.

8. **Aphanobasidium pseudotsugae** (Burt) Boidin & Gilles, Cryptog. Bot. 1: 75, 1989. – *Phlebiella pseudotsugae* (Burt) K.H. Larss. & Hjortstam / 7 / 28 May 1997 / Yurchenko (2000a) / 10 / S.

9. **Asterodon ferruginosus** Pat., Bull. Soc. Mycol. France 10: 130, 1894 / 2 / 21 Oct 1964 / Komarova & Golovko (1965) / 2*, 10, 19*, 23*, 26*, 30* / S.

10. **Athelia arachnoidea** (Berk.) Jülich, Willdenowia, Beih. 7: 53, 1972 / 6 / 27 Aug 1995 / Yurchenko (2000d) / 4, 10, 13, *18* / S, P.

The species commonly develops in a sterile state lacking hymenium and spores, and so can not be identified with confidence, except when it forms characteristic "mycelial rings" or lesions in algal and lichen cover.

11. **Athelia binucleospora** J. Erikss. & Ryvarden, Cort. N. Eur. 2: 105, 1973 / MSK 4522 / 11 Jul 1998 / Yurchenko (2000a) / 10 / S.

The specimen has ovoid spores with maximum width in the middle or towards the apex, (3.5) 5–6.3 × (2.3) 3–4 µm, basidia 13–16 × 5 µm, and basal hyphae 2.5–6.5 µm wide.

12. **Athelia decipiens** (Höhn. & Litsch.) J. Erikss., Symb. Bot. Upsal. 16 (1): 86, 1958; *A. griseoalba* Parmasto / MSK 3891/ 22 Sep 1963 / Komarova (1966) 'grisio-alba' / 26 / S.

The specimen has spores 3.5–5.5 × 2.5–3 µm.

13. **Athelia epiphylla** Pers., Mycol. Eur. 1: 84, 1822. – *Thelephora epiphylla* Pers. : Fr., Elench. fung. 1: 226, 1828 / 9 / 11 Jul 1998 / Komarova (1966) / 10, 13, 21, 23, 26* / S, LM, LF.

Those specimens where spores are absent or very scarce, with scattered clamps only on basal hyphae and, frequently, hymenium consisting of basidioles, are treat under the epithet: **Athelia epiphylla** complex / 16 / 21 Oct 1964 / Yurchenko (2000a) / 10, 12 / S, LM, LF.

14. **Athelia ovata** Jülich, Willdenowia, Beih. 7: 106, 1972 / 3 / 28 May 1997 / Yurchenko (1998b) sub nom. *A.* aff. *ovata* / 10 / S, LM, LF.

Specimens MSK 4051 and 4066 with smaller spores, (4.5) 5.5–7 (8) × (2.3) 2.5–3.5 (4) µm, longer and narrower basidia, 11–20 (22.5) × (3.5) 4–6 µm, and hyphae narrower, 2–4 (6.5) µm, than in typical *A. ovata* are listed under the name *A.* aff. *ovata* (Yurchenko, 1998b; 2001a).

15. **Athelia salicum** Pers., Mycol. Eur. 1: 84, 1822. – *Athelia incrustata* M.P. Christ. / MSK 4335 / 13 Nov 1997 / Komarova (1966) / 10 / S.

16. **Auriscalpium vulgare** Gray, Nat. arr. Br. pl. 1: 650, 1821 / 2 / 12 May 1984 / *Nikolajeva (1961)*, Komarova & Golovko (1965) / 10*, *11*, *13*, 23* / S.

17. **Bankera fuligineoalba** (Schmidt : Fr.) Pouzar, Česká Mykol. 9: 96, 1955. – *Sarcodon fuligineo-albus* (Schmidt : Fr.) Quél. / 2 / 23 Aug 1973 / Komarova & Golovko (1965) / 10, *11**, 26*, 30 / E, LM.

18. **Bankera violascens** (Alb. & Schwein. : Fr.) Pouzar, Česká Mykol. 9: 96, 1955. – *Hydnum violascens* Alb. & Schwein. : Fr. – *H. cinereum* Bull. : Fr. non Batsch : Pers. /// Kuprevich (1931a) / 13* / E.

19. **Basidioradulum radula** (Fr. : Fr.) Nobles, Mycologia 59: 192, 1967. – *Radulum orbiculare* Fr. ex Grev. / 4 / 15 Nov 1992 / Wyssotzky *et al.* (1925) / 2*, 4*, 6*, 10, 13, 26, 27* / S.

20. **Botryobasidium candicans** J. Erikss., Svensk Bot. Tidskr. 52 (1): 6, 1958. – *Haplotrichum capitatum* (Link : Fr.) Willd., Sp. pl. 6 (1): 52, 1824 nom. anam. / 8 / 21 Sep 1963 / Yurchenko (1998c) / 10, 26 / S.

First collection and report of anamorph: 29 May 1997 (MSK 4056) / Yurchenko (1998c).

21. **Botryobasidium laeve** (J. Erikss.) Parmasto, Eesti NSV Tead. Akad. Toim. Biol. 14 (4): 220, 1965 / 8 / 11 Jul 1998 / Komarova (1966) / 10, 13, 14, 26* / S, LM.

Under this epithet specimen MSK 5109 with some basal hyphae loosely encrusted is also to be listed.

22. **Botryobasidium medium** J. Erikss., Symb. Bot. Upsal. 16 (1): 54, 1958. – *Haplotrichum medium* (Hol.-Jech.) Hol.-Jech., Česká Mykol. 30 (1): 4, 1976 nom. anam. / 3 / 28 May 1997 / Yurchenko (1998b) sub nom. *B.* aff. *medium* / 10 / S.

First collection and report of anamorph: 28 May 1997 (MSK 4075) / Yurchenko (1998c). MSK 4078 differs from the species concept because of small, short navicular or broadly fusiform-ellipsoid basidiospores, (5.5) 6.5–9 × (3.7) 4–5.5 µm.

23. **Botryobasidium subcoronatum** (Höhn. & Litsch.) Donk, Meded. Ned. Mycol. Ver. 18–20: 117 (1931) / 13 / 10 Jul 1998 / Komarova (1966) / 10, 13, 26*, *30** / S, LM.

24. **Botryobasidium vagum** (Berk. & M.A. Curtis) D.P. Rogers, Stud. Nat. Hist. Iowa Univ. 17 (1): 17, 1935; *B. botryosum* (Bres.) J. Erikss. / 3 / 7 Sep 1960 / Komarova (1966) / 2, 10 / S.

MSK 3897 differs from the species concept in having small basidia, 14–18 × 8–9 µm, and small spores, 7.5–9 × 3.3–3.5 µm. In MSK 4453 spores 7–11.5 × 3.7–4.5 µm.

25. **Botryohypochnus isabellinus** (Fr. : Fr.) J. Erikss., Svensk Bot. Tidskr. 52 (1): 2, 1958 / 5 / 21 Sep 1963 / Komarova (1966) / 4, 10, 19*, 26, 30 / S.

26. **Brevicellicium olivascens** (Bres.) K.H. Larss. & Hjortstam, Mycotaxon 7 (1): 119, 1978; *Grandinia mutabilis* (Pers.) Bourdot & Galzin / 10 / 29 Jun 1995 / Yurchenko (2000d) / 10, 12, 13, *14*, 31 / S, LM.

27. **Byssocorticium atrovirens** (Fr. : Fr.) Bondartsev & Singer ex Singer, Mycologia 36 (1): 69, 1944. – *Corticium atrovirens* (Fr. : Fr.) Fr. / MSK 3902 / 31 Aug 1966 / Komarova *et al.* (1968) / 23 / S.

28. **Byssomerulius albostramineus** (Torrend) Hjortstam, Windahlia 17: 56, 1987; *Merulius rubicundus* Litsch. – *Byssomerulius rubicundus* (Litsch.) Parmasto / 4 / 19 Aug 1956 / Komarova (1965) / 30 / S.

We did not find any differences of taxonomic value between *B. rubicundus* and *B. albostramineus* and treat them as synonyms following Jülich (1984) and Domański (1988).

29. **Byssomerulius corium** (Pers. : Fr.) Parmasto, Eesti NSV Tead. Akad. Toim. Biol. 16 (4): 383, 1967. – *Merulius corium* (Pers. : Fr.) Fr. / 10 / 8 Oct 1969 / Komarova (1965) / 10, 12, 13, 19*, 23, 24, 28, *30** / S.

30. **Cantharellus cibarius** Fr. : Fr., Syst. mycol. 1: 318, 1821 / 2 / 3 Aug 1957 / Lebedeva (1925b) / widespread and common, e.g. *11*, *13**, *20**, 23*, 26* / E.

31. **Cantharellus cinereus** Pers. : Fr., Syst. mycol. 1: 320, 1821. – *Craterellus cinereus* (Pers. : Fr.) Pers. / 3 / 30 Sep 1978 / Yurchenko (2002) / 13, 26 / E.

32. **Cantharellus tubaeformis** Bull. : Fr., Syst. mycol. 1: 319, 1821 'tubiformis'. – *C. tubaeformis* var. *lutescens* Fr. – *C. lutescens* (Pers. : Fr.) Fr. / MSK 3738 / 23 Sep 1964 / Serzhanina & Zmitrovich (1986) / 23 / E.

This species was also reported from north part of Belarus, without precise information on localities (Kolmakov, 2002).

33. **Ceraceomyces eludens** K.H. Larss. in K.H. Larss. & E. Larss., Folia Crypt. Est. 33: 74, 1998; *C. sublaevis* (Bres.) Jülich sensu Jülich (nom. conf.) / 4 / 13 Nov 1997 / Yurchenko (2000a) / 10, 14 / S.

On some labels the incorrectly used epithet for *C. eludens* and *C. microsporus* is *Athelia sublaevis* (Bres.) Parmasto, now synonymized with *Metulodontia nivea* (P. Karst.) Parmasto.

34. **Ceraceomyces microsporus** K.H. Larss. in K.H. Larss. & E. Larss., Folia Crypt. Est. 33: 75, 1998; *C. sublaevis* (Bres.) Jülich sensu Jülich (nom. conf.) / 10 / 10 Nov 1997 / Yurchenko (2000a) / 2, 10, 14 / S, LM.

35. **Ceraceomyces serpens** (Tode : Fr.) Ginns, Canad. J. Bot. 54 (1–2): 147, 1976. – *Merulius serpens* Tode : Fr.; *M. porinoides* Fr. : Fr. / 3 / 14 Aug 1956 / Komarova (1965) / 10, 19, 23*, 26*, 30 / S.

The specimen MSK 4448 has cylindrical to slightly sigmoid or *Botryobasidium*-like spores, narrowed towards the tip and smaller than in typical *C. serpens*, (4.5) 5.5–7.5 (9) × 2.5–3 (3.3) µm.

36. **Ceraceomyces sulphurinus** (P. Karst.) J. Erikss. & Ryvarden in J. Erikss. *et al.*[*], Cort. N. Eur. 5: 895, 1978. – *Phanerochaete sulphurina* (P. Karst.) Budington & Gilb. / 1 (MSK 3952) / 21 Sep 1963 / Komarova (1966) / 26 / S.

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[*] J. Erikss. *et al.* = J. Erikss., Hjortstam & Ryvarden

37. **Ceraceomyces violascens** (Fr. : Fr.) Jülich, Willdenovia, Beih. 7: 162, 1972. – *Athelia violascens* (Fr. : Fr.) Donk /// Komarova (1966) / 2* / S.

38. **Ceratobasidium cornigerum** (Bourdot) D.P. Rogers, Stud. Nat. Hist. Iowa Univ. 17 (1): 5, 1935 / 8 / 4 Jun 1994 / Yurchenko (1998b) / 10, 12, 21 / S, LM.

39. ***Ceratobasidium** aff. **pseudocornigerum** M.P. Christ, Dansk Bot. Ark. 19 (2): 46, 1959 / MSK 4112 / 14 Jul 1997 / 10 / S.

The fungus occurs on dead stem bases of *Chamerion angustifolium*, with hyphae (3.5) 4–7 (11.5) µm wide, basal ones hyaline to brownish, smooth or loosely to heavily encrusted; basidia 12–15 × 7–9 µm; spores navicular, allantoid, elongated navicular to slightly sigmoid, 7–12.5 × (2.5) 3–4 µm, content with an almost central, sometimes elongated drop.

40. ***Ceratobasidium** aff. **ramicola** C.C. Tu, D.A. Roberts & Kimbr., Mycologia 61 (4): 781, 1969 / MSK 8059 / 4 Oct 2000 // 21 / P.

The fungus occurs on needles of *Juniperus communis*. Basidioma very thin, white, porulose-discontinuous, from the both leaf sides. This specimen differs from North American species *C. ramicola* in having basidia 10–14 × 6.5–8.5 µm, with 2–4 sterigmata *ca* 9–10 × 1.7 µm when maximally elongated, and narrow hyphae 3.3–7 µm. The ellipsoid to short cylindrical basidiospores 5–7 (8.5) × (2.5) 3–6 µm are smaller than in *C. cornigerum*.

41. **Chondrostereum purpureum** (Pers. : Fr.) Pouzar, Česká Mykol. 13 (1): 17, 1959. – *Stereum purpureum* Pers. : Fr. / 22 / 6 Sep 1962 / Lebedeva (1925a) / 10, 13, 23, 26 / S, P.

42. **Clavaria fumosa** Pers. : Fr., Syst. mycol. 1: 483, 1821 /// Kapich & Golovko (1992) / *13* / S.

43. ***Clavariadelphus fistulosus** (Holmsk. : Fr.) Corner, Ann. Bot. Mem. 1: 272, 1950. – *Macrotyphula fistulosa* (Holmsk. : Fr.) R.H. Petersen / MSK 3579 / 6 Oct 1977 // *13* / S, (S).

44. ***Clavariadelphus junceus** (Alb. & Schwein. : Fr.) Corner, Ann. Bot. Mem. 1: 275, 1950. – *Macrotyphula juncea* (Alb. & Schwein. : Fr.) Berthier / 2 / 17 Oct 1985 // 13, 21 / S.

45. **Clavariadelphus ligula** (Schaeff. : Fr.) Donk, Rev. Niederl. Homob. Aphyll. 2: 73, 1933. – *Clavaria ligula* Schaeff. : Fr. / 13 / 1978 / Kuprevich (1931a) / 13, *20**, 21, 23*, 26 / S.

46. **Clavariadelphus pistillaris** (L. : Fr.) Donk, Rev. Niederl. Homob. Aphyll. 2: 73, 1933. – *Clavaria pistillaris* L. : Fr. /// Kuprevich (1931b) / *4**, *13**, 23*, 26*, 30* / (S).

47. **Clavicorona pyxidata** (Pers. : Fr.) Doty, Lloydia 10: 43, 1947. – *Clavaria pyxidata* Pers. : Fr. – *Artomyces pyxidatus* (Pers. : Fr.) Jülich / MSK 3805 / 27 Aug 1978 / Lebedeva (1925b) / *13**, *20**, 26*, 30 / S.

48. **Clavulina cinerea** (Bull. : Fr.) J. Schröt. in Cohn, Krypt.-Fl. Schles. 3 (1): 442, 1888 / 3 / 6 Sep 1977 / Anonymous (1984) / 13*, *26*, *27* / S, (S).

In MSK 3834b basidiomata form a complex with the parasitic fungus *Helminthosphaeria clavariarum* (Tul.) Fuckel (*Spadicoides clavariarum* (Desm.) S. Hughes nom. anam.).

49. **Clavulina coralloides** (L. : Fr.) J. Schröt. in Cohn, Krypt.-Fl. Schles. 3 (1): 443, 1888. – *Clavaria coralloides* L. : Fr.; *Clavaria cristata* Holmsk. : Fr. – *Clavulina cristata* (Holmsk. : Fr.) J. Schröt. / 5 / 21 Aug 1967 / Kuprevich (1931b) / 13, *20**, *27*, 30 / S.

50. **Clavulinopsis corniculata** (Schaeff. : Fr.) Corner, Ann. Bot. Mem. 1: 362, 1950; *Clavaria fastigiata* Fr. /// Kuprevich (1931b) / 13 / S.

51. ***Clavulinopsis laeticolor** (Berk. & M.A. Curtis) R.H. Petersen, Mycologia 57: 522, 1965 / MSK 3857 / Oct 1981 // 13 / S.

52. **Climacodon pulcherrimus** (Berk. & M.A. Curtis) Nikol., Fl. pl. crypt. URSS 6 (2): 194, 1961 / 2 / 27 Jul 1958 / Komarova & Golovko (1966) / 30 / S.

53. **Climacodon septentrionalis** (Fr.) P. Karst., Rev. Mycol. (Toulouse) 3 (9): 20, 1881. – *Hydnum septentrionale* Fr. – *C. septentrionalis* (Fr.) P. Karst., Meddeland. Soc. Fauna Fl. Fenn. 6: 15, 1881 / MSK 3865 / Sep 1977 / Dorogin, 1912 – see Komarova & Golovko (1965) / 13, 23*, 27*, 31*, 32* / S, P.

54. **Conferticium ochraceum** (Fr. : Fr.) Hallenb., Mycotaxon 11 (2): 448, 1980. – *Corticium ochraceum* (Fr. : Fr.) Fr. / 2 / 9 Oct 1969 / Lebedeva (1925b) / 10, 12, *13** / S.

55. **Coniophora arida** (Fr.) P. Karst., Not. Sällsk. Fauna Fl. Fenn. Förh. II 6: 370, 1868 / 6 / 20 Oct 1964 / Komarova (1966) / 10, 23, 26* / S.

56. **Coniophora olivacea** (Fr. : Fr.) P. Karst., Bidrag Kännedom Finlands Natur Folk 37: 162, 1882. – *Coniophorella olivacea* (Pers. : Fr.) P. Karst. / 3 / Sep 1962 / Komarova (1966) / 10, 23*, 26 / S.

57. **Coniophora puteana** (Schumach. : Fr.) P. Karst., Not. Sällsk. Fauna Fl. Fenn. Förh. II 6: 370, 1868. – *C. cerebella* Pers. / 2 / 5 Sep 1962 / Golovko (1966) / 10 / S.

58. ***Corticium quercicola** Jülich, Int. J. Mycol. Lichenol. 1(1): 31, 1982 / 3 / 28 Mar 1998 /// 4, 24, 30 / S.

A correct systematic position of the species may be the genus *Erythricium.*

59. **Corticium roseum** Pers., Neues Mag. Bot. 1: 111, 1794. – *Thelephora rosea* (Pers.) Pers. : Fr., Syst. mycol. 1: 451, 1821. – *Laeticorticium roseum* (Pers.) Donk / 5 / 5 Sep 1962 / Komarova (1966) / 2*, 10, 30* / S.

60. **Craterellus cornucopioides** (L. : Fr.) Pers., Mycol. Eur. 2: 5, 1825 / 4 / 18 Sep 1959 / *Wyssotzky et al. (1925, dubious data)*, Serzhanina (1967) / 13, 26, 23* / E.

The report by Wyssotzky *et al.* (1925) and Lebedeva (1925b) of finding the fungus on stumps in district N° 32 is dubious; that fungus was probably *Lentinellus cochleatus* (Pers. : Fr.) P. Karst.

61. **Creolophus cirrhatus** (Pers. : Fr.) P. Karst., Meddeland. Soc. Fauna Fl. Fenn. 5: 42, 1879. – *Hericium cirrhatum* (Pers. : Fr.) Nikol. / 5 / Aug 1953 / Komarova & Golovko (1965) / 2, 10*, 13, 19, 23, *25* / S, P.

62. **Crustoderma dryinum** (Berk. & M.A. Curtis) Parmasto, Consp. syst. Cortic. 88, 1968. – *Corticium dryinum* Berk. & M.A. Curtis – *Peniophora dryina* (Berk. & M.A. Curtis) D.P. Rogers & S.H. Jacks. / 2 / 20 Aug 1963 / Komarova (1966) / 2, *30* / S.

63. **Crustomyces subabruptus** (Bourdot & Galzin) Jülich, Persoonia 10 (1): 140, 1978. – *Odontia subabrupta* Bourdot & Galzin / 6 / 15 Aug 1956 / Komarova (1966) / 4, 26, 30 / S.

64. **Cylindrobasidium evolvens** (Fr. : Fr.) Jülich, Persoonia 8 (1): 72, 1974. – *Corticium evolvens* (Fr. : Fr.) Fr. / 33 / 23 Dec 1992 / Golovko (1966) / *3*, 10, 13, 14, 19*, 21, 28, 31 / S, W, LF.

Corticium laeve Pers. : Fr. and *Cylindrobasidium laeve* (Pers. : Fr.) Chamuris were synonymized with *Phanerochaete laevis* by Parmasto (1997), but the names have been misapplied in a number of sources and labels for *Cylindrobasidium evolvens*.

65. **Cytidia salicina** (Fr. : Fr.) Burt, Ann. Missouri Bot. Gard. 11: 10, 1924 / MSK 4477 / 23 Sep 1998 / Yurchenko (2000d) / 13 / S.

66. **Dendrophora versiformis** (Berk. & M.A. Curtis) Chamuris, Mycotaxon 28 (2): 544, 1987 / MSK 4595 / 22 Jul 1995 / Yurchenko (2000d) / 31 / S.

67. **Dendrothele alliacea** (Quél.) P.A. Lemke, Persoonia 3 (3): 366, 1965 / 3 / 21 Aug 1924 / Yurchenko (2000d) / 24, *31*, 32 / B.

68. **Dentipellis dissita** (Berk. & Cooke) Maas Geest., Persoonia 7 (4): 551, 1974 / MSK 4526 / 11 Jul 1998 / Yurchenko (2000a) / 10 / S, LM.

The differences between *D. dissita* and *D. fragilis* are not distinct. MSK 4526 has gloeocystidia small-segmented by constrictions, (4) 5–8 (9.5) µm wide and 20–60 µm long (excluding hypha-like base), and spores 3–5 (6) × (2.5) 3–4 (4.3) µm.

69. **Dentipellis fragilis** (Pers. : Fr.) Donk, Persoonia 2 (2): 233, 1962. – *Hericium fragile* (Pers. : Fr.) Kotlaba – *H. fragile* (Pers. : Fr.) Nikol. / 6 / 13 Sep 1957 / Komarova & Golovko (1965) / 23, *29*, 30 / S, LM.

70. **Dichostereum granulosum** (Pers. : Fr.) Boidin & Lanquetin, Mycotaxon 6 (2): 284, 1977. – *Vararia granulosa* (Pers. : Fr.) Laurila / MSK 3900 / 13 Sep 1957 / Komarova (1966) / 23 / S.

71. **Gloeocystidiellum porosum** (Berk. & M.A. Curtis) Donk, Meded. Ned. Mycol. Ver. 18–20: 156, 1931 / 6 / 6 Aug 1995 / Yurchenko (2000a) / 10, 13, *18* / S.

In all specimens studied, using Melzer's reagent, spores have minute and scattered, scarcely visible warts.

72. **Gloeopeniophorella convolvens** (P. Karst.) Boidin, Lanquetin & Gilles, Bull. Soc. Mycol. France 113: 45, 1997. – *Gloeocystidiellum convolvens* (P. Karst.) Donk / 6 / 13 Sep 1956 / Komarova (1966) / 2, 10*, 23, *30* / S.

73. **Gloiodon strigosus** (Sw. : Fr.) P. Karst., Meddeland. Soc. Fauna Fl. Fenn. 5: 42, 1879 'strigosum'. – *Sclerodon strigosus* (Sw. : Fr.) P. Karst. /// *Nikolajeva (1961)* // S.

74. **Gloiothele citrina** (Pers.) Ginns & G.W. Freeman, Biblioth. Mycol. 157: 55, 1994. – *Vesiculomyces citrinus* (Pers.) E. Hagstr.; *Gloeocystidiellum radiosum* (Fr. : Fr.) Boidin / 8 / 5 Sep 1962 / Komarova (1966) / 2*, 10, 13, 14, 18, 23*, 26*, 30* / S, LM.

75. **Gloiothele lactescens** (Berk.) Hjortstam, Windahlia 17: 58, 1987. –*Gloeocystidiellum lactescens* (Berk.) Boidin / 3 / 28 Aug 1957 / Komarova (1966) / 19, 28 / S.

76. **Hericium coralloides** (Scop. : Fr.) Pers., Neues Mag. Bot. 1: 109, 1794, sec. Hallenberg (1983) & Stalpers (1996), nom. illeg. sec. Maas Geesteranus (1971). – *H. coralloides* (Scop. : Fr.) Gray, Nat. arr. Br. pl. 1: 652, 1821, nom. leg. sec. Maas Geesteranus (1971). – *H. clathroides* (Pall. : Fr.) Pers. – *H. ramosum* (Bull. ex Mérat) Letell. / 14 / 19 Aug 1956 / B_o_ski, 1889 – see Komarova & Golovko (1965) / 10, *13**, *20**, 21, 23, 26, 30, 31* / S.

Following the key in Stalpers (1996), *H. clathroides* is a small-spored form of *H. coralloides*. The species concept of *H. coralloide*s sensu Maas Geesteranus (1971) fits the concept of *H. flagellum* complex sensu Stalpers (1996). In the Red Data Book of Belarus (Golovko & Serzhanina, 1993) *H. clathroides* was included as an independent species.

77. **Hydnellum aurantiacum** (Batsch. : Fr.) P. Karst., Meddeland. Soc. Fauna Fl. Fenn. 5: 41, 1879 /// Komarova & Golovko (1966) / 31* / E.

78. **Hydnellum compactum** (Pers. : Fr.) P. Karst., Meddeland. Soc. Fauna Fl. Fenn. 5: 41, 1879. – *Hydnum compactum* Pers. : Fr. – *Hydnellum compactum* (Pers. : Fr.) Nikol., Trudy Bot. Inst. Akad. Nauk SSSR, Ser. 2, Sporov. Rast. 9: 471, 1954. /// Komarova & Golovko (1965) / 10*, *13**, 23* / E.

79. **Hydnellum concrescens** (Pers. ex Schwein.) Banker, Mem. Torrey Bot. Club 12: 157, 1906; *H. zonatum* (Fr.) P. Karst. /// *Nikolajeva (1961)* // E.

80. **Hydnellum ferrugineum** (Fr. : Fr.) P. Karst., Meddeland. Soc. Fauna Fl. Fenn. 5: 41, 1879. – *Hydnum ferrugineum* Fr. non Pers.; *Hydnellum carbunculum* (Secr.) Banker / MSK 21 / 13 Aug 1974 / Komarova & Golovko (1965) / 2*, 13*, 30 / E.

81. **Hydnum repandum** L. : Fr., Syst. mycol. 1: 400, 1821 / MSK 3611 / 28 Sep 1960 / B_o_ski, 1889 – see Komarova & Golovko (1965) / 13*, 19, *20**, 23* / E.

82. ***Hydnum rufescens** Fr., Syst. mycol. 1: 401, 1821 non *H. rufescens* Schaeff., 1774 / 2 / 25 Aug 1965 // 13, 31 / E.

The specimens studied differed from typical *H. rufescens* in having a brownish yellow pileus, an excentric stipe, flesh lacking pink tinge, and aculei not distinctly decurrent on the stipe.

83. **Hymenochaete cinnamomea** (Pers. : Fr.) Bres., Atti Imp. Regia Accad. Rovereto III 3 (1): 110, 1897; *H. arida* (P. Karst.) Sacc. / 4 / 15 Jul 1997 / Komarova (1966) / 10, *19**, 23*, 30* / S, LM.

Hymenochaete arida is treated here as a young stages of *H. cinnamomea* basidiomata - see also Nordic macromycetes , Hansen & Knudsen (1997).

84. **Hymenochaete fuliginosa** (Pers.) Lév., Ann. Sci. Nat., Bot. III 5: 152, 1846; *H. subfuliginosa* Bourdot & Galzin /// Bondarceva, Parmasto (1986) / *23** / S.

85. **Hymenochaete rubiginosa** (Dicks. : Fr.) Lév., Ann. Sci. Nat., Bot. III 5: 151, 1846 / MSK 3948 / 17 Aug 1963 / Komarova *et al.* (1968) / 23*, 26*, 27*, *30*, 30* / S.

86. **Hymenochaete tabacina** (Sowerby : Fr.) Lév., Ann. Sci. Nat., Bot. III 5: 145, 1846 / 34 / 21 Oct 1964 / Komarova *et al.* (1968) / 2, 5, 10, 12, 13, *14*, 23, 30* / S.

87. **Hyphoderma argillaceum** (Bres.) Donk, Fungus 27: 14, 1957 / 1 / 19 Sep 2001 / Komarova (1966) / 14, 30* / S.

88. **Hyphoderma definitum** (H.S. Jacks.) Donk, Fungus 27: 15, 1957 / MSK 4443 / 12 Jul 1998 / Yurchenko (2000a) / 10 / S.

89. ***Hyphoderma litschaueri** (Burt) J. Erikss. & Å. Strid in J. Erikss. & Ryvarden, Cort. N. Eur. 3: 481, 1975 / MSK 3781 / 20 Aug 1963 // *30* / S.

90. ***Hyphoderma medioburiense** (Burt) Donk, Fungus 27: 15, 1957 / 2 / 29 Aug 1996 // 18, 24 / S.

91. **Hyphoderma mutatum** (Peck) Donk, Fungus 27: 15, 1957. – *Radulum mutatum* (Peck) Nikol. / 5 / 27 Dec 1992 / Komarova (1966) and simultaneously Komarova & Golovko (1966) / *3*, 13, 19, 23*, 31 / S, B.

92. ***Hyphoderma pallidum** (Bres.) Donk, Fungus 27: 15, 1957 / MSK 6151 / 22 Sep 2001 // 14 / S.

93. **Hyphoderma praetermissum** (P. Karst.) J. Erikss. & Å. Strid in J. Erikss. & Ryvarden, Cort. N. Eur. 3: 505, 1975; *H. tenue* (Pat.) Donk / 27 / 11 Aug 1956 / Komarova (1966) / 10, 13, 14, 23, 26, 28, 30 / S, LM, LF.

A very variable taxon which could also fit in the wider concept provided by the *Hyphoderma praetermissum* complex.

94. **Hyphoderma puberum** (Fr. : Fr.) Wallr., Fl. crypt. Germ. 2: 576, 1833. – *Phlebia pubera* (Fr. : Fr.) M.P. Christ. / 12 / 22 Aug 1963 / Komarova (1966) / 10, 13, 14, *30* / S, LM.

95. **Hyphoderma roseocremeum** (Bres.) Donk, Fungus 27: 15 (1957) /// Komarova (1966) / 30* / S.

96. **Hyphoderma setigerum** (Fr. : Fr.) Donk, Fungus 27: 15, 1957 / 52 / 18 Aug 1963 / Komarova (1966) / *3*, 10, 13, 14, 18, 20, 21, 23, 26, 30, 31 / S, B, LM.

A rather variable taxon which could also fit in the wider concept provided by the *Hyphoderma setigerum* complex (Yurchenko & Zmitrovich, 2001).

97. **Hyphodontia abieticola** (Bourdot & Galzin) J. Erikss., Symb. Bot. Upsal. 16 (1): 104, 1958 /// Komarova (1966) / *30** / S.

98. **Hyphodontia alutacea** (Fr. : Fr.) J. Erikss., Symb. Bot. Upsal. 16 (1): 104, 1958. – *Odontia alutacea* (Fr. : Fr.) Quél. / 4 / 21 Aug 1964 / Komarova (1966) and simultaneously Komarova & Golovko (1966) / 10, 23* / S, LM.

99. **Hyphodontia arguta** (Fr. : Fr.) J. Erikss., Symb. Bot. Upsal. 16 (1): 104, 1958. – *Odontia arguta* (Fr. : Fr.) Quél. / MSK 3927 / 12 Aug 1956 /

Nikolajeva (1961), Komarova (1966) and simultaneously Komarova & Golovko (1966) / 10*, 23*, 26*, 30 / S .

100. **Hyphodontia aspera** (Fr.) J. Erikss., Symb. Bot. Upsal. 16 (1): 104, 1958. – *Odontia aspera* (Fr.) Pilát / 8 / 5 Sep 1962 / Komarova & Golovko (1965) / 10, 19*, 23*, 26*, *30*, 30* / S, LM.

101. **Hyphodontia barba-jovis** (Bull. : Fr.) J. Erikss., Symb. Bot. Upsal. 16 (1): 104, 1958. – *Odontia barba-jovis* (Bull. : Fr.) Fr. / 10 / 29 Sep 1993 / *Nikolajeva (1961)*, Komarova (1966) and simultaneously Komarova & Golovko (1966) / 10, 13, 23, *30** / S, LM.

102. **Hyphodontia breviseta** (P. Karst.) J. Erikss., Symb. Bot. Upsal. 16 (1): 10, 1958; *Odontia lactea* (P. Karst.) P. Karst. – *Denticularia limoniformis* de Hoog nom. anam. / 14 / 20 Oct 1964 / Komarova (1966) and simultaneously Komarova & Golovko (1966) / 10, 13, 23 / S, LM.

First collection and report of anamorph: 25 Sep 1964 (MSK 3656) / Yurchenko (1998c). In Belarus conidia were not collected separately from basidiomata.

103. **Hyphodontia crustosa** (Pers. : Fr.) J. Erikss., Symb. Bot. Upsal. 16 (1): 104, 1958. – *Odontia crustosa* Pers. : Fr. / 2 / 13 Nov 1997 / *Nikolajeva (1961)*, Komarova & Golovko (1966) / 10, 26* / S.

104. **Hyphodontia floccosa** (Bourdot & Galzin) J. Erikss., Symb. Bot. Upsal. 16 (1): 104, 1958 / MSK 4755 / 3 Jun 1999 / Yurchenko (2001a) / 10 / S, LM.

105. **Hyphodontia nespori** (Bres.) J. Erikss. & Hjortstam in J. Erikss. & Ryvarden, Cort. N. Eur. 4: 655, 1976. – 'nesporii' (Parmasto, 1997) / 6 / 20 Aug 1963 / *Nikolajeva (1961)* sub nom. *O. papillosa*, Yurchenko (2000d) / 13, *30* / S.

In Nikolajeva (1961: 123–124) the name *O. papillosa* was clearly applied incorrectly to *Hyphodontia nespori*.

106. **Hyphodontia pallidula** (Bres.) J. Erikss., Symb. Bot. Upsal. 16 (1): 104, 1958 / 10 / 7 Sep 1960 / Komarova (1966) / 2, *10*, 14, 26* / S, LM.

107. **Hyphodontia pilaecystidiata** (S. Lundell) J. Erikss., Symb. Bot. Upsal. 16 (1): 104, 1958. – 'pilicystidiata' (Parmasto, 1997) / MSK 4723 / 7 Sep 1960 / Yurchenko (2000d) / 10 / S.

108. ***Hyphodontia pruni** (Lasch) Svrček, Česká Mykol. 27 (4): 204, 1973 / MSK 5548 / 15 Nov 1992 // 26 / S.

109. ***Hyphodontia quercina** (Pers. : Fr.) J. Erikss., Symb. Bot. Upsal. 16 (1): 105, 1958. – *Radulum quercinum* (Pers. : Fr.) Fr. / MSK 3880 / 23 Sep 1964 // 23 / S.

110. **Hyphodontia rimosissima** (Peck) Gilb., Mycologia 54: 667, 1962. – *Odontia papillosa* (Fr. : Fr.) P. Karst. / 3 / 6 Sep 1995 / Komarova & Golovko (1966) / 10, 13, *30** / S, LM.

In MSK 4160 and 4161 spores are ellipsoid to cylindrical, (4) 5–6.5 × 2.3–3.5 μm.

111. **Hyphodontia sambuci** (Pers. : Fr.) J. Erikss., Symb. Bot. Upsal. 16 (1): 104, 1958. – *Lyomyces sambuci* (Pers. : Fr.) P. Karst. / 17 / 1 Nov 1992 / Komarova (1966) / 4, 10, 13, *14*, 23, 26 / S, LM.

112. ***Hyphodontia spathulata** (Schrad. : Fr.) Parmasto, Consp. syst. Cortic. 123, 1968 / 3 / 17 Aug 1963 // 10, *30* / S.

113. **Hyphodontia subalutacea** (P. Karst.) J. Erikss., Symb. Bot. Upsal. 16 (1): 104, 1958 / 12 / 28 May 1997 / Komarova (1966) / 10, 12, 13, 23*, 26*, *30** / S.

114. **Hypochnicium bombycinum** (Sommerf. : Fr.) J. Erikss., Symb. Bot. Upsal. 16 (1): 101, 1958 / 7 / 18 Sep 1993 / Yurchenko (1998a) / 13 / S, B.

115. ***Hypochnicium eichleri** (Bres.) J. Erikss. & Ryvarden, Cort. N. Eur. 4: 707, 1976 / MSK 5140 / 14 Aug 1994 // 13 / S.

Incl. **Hypochnicium eichleri-punctulatum** / 3 / 6 Sep 1962 / Yurchenko (1998c) / 10 / S.

The epithet "eichleri-punctulatum" is used here for specimens with intermediate morphology following Hallenberg (1985).

116. **Hypochnicium erikssonii** Hallenb. & Hjortstam, Windahlia 18: 44, 1989 / MSK 4884 / 4 Jul 1999 / Yurchenko (2000d) / 10 / S.

117. **Hypochnicium geogenium** (Bres.) J. Erikss., Symb. Bot. Upsal. 16 (1): 101, 1958 / MSK 3906 / 28 Sep 1965 / Yurchenko (2000d) / 23 / S.

118. ***Hypochnicium lundellii** (Bourdot) J. Erikss., Symb. Bot. Upsal. 16 (1): 101, 1958 / MSK 5776 / 22 Apr 2001 // *14* / S.

119. **Hypochnicium multiforme** (Berk. & Broome) Hjortstam, Windahlia 23: 2, 1998; *Dacryobolus karstenii* (Bres.) Oberw. ex Parmasto /// *Davydkina (1980)* // S.

120. **Hypochnicium punctulatum** (Cooke) J. Erikss., Symb. Bot. Upsal. 16 (1): 101, 1958 /// Komarova (1966) / 10* / S.

121. **Hypochnicium vellereum** (Ellis & Cragin) Parmasto, Consp. syst. Cortic. 116, 1968. – *Granulobasidium vellereum* (Ellis & Cragin) Jülich / MSK 3587 / Oct 1978 / *26* / S.

122. **Irpex lacteus** (Fr. : Fr.) Fr., Elench. fung. 1: 145, 1828; *I. sinuosus* Fr. / 4 / 22 Jul 1995 / Lebedeva (1925a) and simultaneously Wyssotzky *et al.* (1925) / 10*, 13, 23*, 26*, 31, 32* / S.

123. **Kavinia himantia** (Schwein. : Fr.) J. Erikss., Symb. Bot. Upsal. 16 (1): 160, 1958 / 2 / 23 Sep 1963 / Yurchenko (2000d) / 13, 26 / S, LM.

124. **Lagarobasidium detriticum** (Bourdot) Jülich, Persoonia 10 (3): 334, 1979 / 6 / 21 Sep 1964 / Yurchenko (2000d) / 10, *14*, 23, 26 / S.

125. **Laxitextum bicolor** (Pers. : Fr.) Lentz, U.S.D.A. Monogr. 24: 19, 1955 / 3 / 30 Aug 1958 / Komarova (1966) / 4, 23, *29* / S, LM.

126. **Lentinellus cochleatus** (Pers. : Fr.) P. Karst., Bidrag Kännedom Finlands Natur Folk 32: 247, 1879. – *Lentinus cochleatus* (Pers. : Fr.) Fr.; *Lentinus cornucopioides* (Bolton) J. Schröt. /// Kuprevich (1931b) / *13** / S.

127. **Leptosporomyces galzinii** (Bourdot) Jülich, Willdenowia, Beih. 7: 192, 1972. – *Athelia galzinii* (Bourdot) Donk / 7 / 26 Sep 1964 / Komarova (1966) / 10, *14*, 21, 23 / S.

128. ***Leptosporomyces mutabilis** (Bres.) Kriegelst., Z. Mykol. 57 (1): 53, 1991. – *Fibulomyces mutabilis* (Bres.) Jülich / MSK 5627 / 11 Jun 2000 // 10 / S.

129. **Megalocystidium leucoxanthum** (Bres.) Jülich, Persoonia 10 (1): 140, 1978. – *Gloeocystidiellum leucoxanthum* (Bres.) Boidin / 9 / 27 Jan 1995 / Yurchenko (1998c) / 2, 10, 23, 24, *27* / S.

130. **Megalocystidium luridum** (Bres.) Jülich, Persoonia 10 (1): 140, 1978. – *Gloeocystidiellum luridum* (Bres.) Boidin, Compt. Rend. Acad. Sci. Paris 233: 1668, 1951 /// Komarova (1966) / 19* / S.

131. ***Merismodes anomalus** (Pers. : Fr.) Singer, Agaricales, 3 ed. 665, 1975. – *Solenia anomala* (Pers. : Fr.) Fuckel – *Cyphellopsis anomala* (Pers. : Fr.) Donk / 10 / 5 Oct 1991 // 5, 10, 13, 28 / S.

132. **Meruliopsis taxicola** (Pers. : Fr.) Bondartsev in Parmasto, Eesti NSV Tead. Akad. Toim. Biol. 8 (4): 274, 1959. – *Merulioporia taxicola* (Pers. : Fr.) Bondartsev & Singer / 2 / Sep 1954 / Bondartsev (1953) / 23, 30 / S.

133. **Peniophora cinerea** (Pers. : Fr.) Cooke, Grevillea 8 (45): 20, 1879 / 173 / 21 Aug 1967 / Lebedeva (1925b) / *1*, 2, *3*, 4, 5, 10, 11, 12, 13, 14, *18*, 20, 21, 23, 24, 26, 28, 29, 30, 31 / S, LF.

134. **Peniophora erikssonii** Boidin, Bull. Soc. Hist. Nat. Toulouse 92: 286, 1957 / 9 / 14 Jun 1997 / Yurchenko (2000a) / 2, 10, 11, 13, 18 / S.

In some instances the epithet *P. aurantiaca* was incorrectly used for this species because the earlier concept of that species included fungi both with and without clamp connections (Eriksson, 1950).

135. **Peniophora incarnata** (Pers. : Fr.) P. Karst., Hedwigia 28: 27, 1889. – *Gloeopeniophora incarnata* (Pers. : Fr.) Höhn. & Litsch. / 113 / 2 May 1989 / Lebedeva (1925b) / 2, 3, 4, 5, 10, 11, 12, 13, 14, 18, 21, 23, 24, 26, 29, 30, 31 / S, W.

136. **Peniophora laeta** (Fr. : Fr.) Donk, Fungus 27: 17, 1957; *P. hydnoidea* (Pers. : Fr.) Donk / 4 / 23 Sep 1964 / Yurchenko (2000c) / *23*, *29*, 30 / S.

137. **Peniophora limitata** (Chaillet ex Fr. : Fr.) Cooke, Grevillea 8 (45): 21, 1879 / 5 / 15 Jul 1997 / Yurchenko (1998c) / 10, 26 / S.

138. **Peniophora nuda** (Fr. : Fr.) Bres., Atti Imp. Regia Accad. Rovereto III 3: 114, 1897 / 8 / 21 Jul 1995 / Yurchenko (1998a) / 13, 31 / S, LF.

139. **Peniophora pini** (Schleich. & DC. : Fr.) Boidin, Rev. Mycol. (Paris) 21: 123, 1956. – *Sterellum pini* (Schleich. & DC. : Fr.) P. Karst. / 9 / 15 Jul 1997 / Komarova *et al.* (1968) / 10, 13, 18, 23*, 26, 29, 30, 32 / S, RD.

140. **Peniophora pithya** (Pers.) J. Erikss., Symb. Bot. Upsal. 10 (5): 45, 1950 / 2 / 4 Oct 1997 / Yurchenko (2000b) sub nom. *P.* aff. *pithya*, Yurchenko (2000c) / 10, 13 / S.

141. **Peniophora polygonia** (Pers. : Fr.) Bourdot & Galzin, Hymen. Fr. 320, 1928 / 17 / 5 Oct 1991 / Yurchenko (1998b) / 4, 10, 12, 13, 18, 23, 24, 26, 29, 30 / S.

142. **Peniophora quercina** (Pers. : Fr.) Cooke, Grevillea 8 (45): 20, 1879 / 16 / 4 Oct 1986 / Novikau & Golovko (1979) / 4, 13, 18, 23, 24, 26*, 30 / S.

143. **Peniophora rufa** (Fr. : Fr.) Boidin, Bull. Soc. Mycol. France 74 (4): 443, 1958 /// *Davydkina (1980)* // S.

144. **Peniophora rufomarginata** (Pers.) Litsch. in Keissler, Kryptog. Exs. Wien no. 2613, 1923 / 4 / 15 Aug 1924 / Yurchenko (2000b) / 13, 20, 23, *31* / S.

145. **Peniophora violaceolivida** (Sommerf.) Massee, J. Linn. Soc., Bot. 25: 152, 1889 / 4 / 19 Oct 1998 / Yurchenko (2000b) / 10, 11, 30 / S.

146. ***Phanerochaete avellanea** (Bres.) J. Erikss. & Hjortstam in J. Erikss. *et al.*, Cort. N. Eur. 6: 1072, 1981; *Athelia subtessulata* Parmasto var. *efibulata* Parmasto / MSK 3890, holotypus var. / 17 Aug 1963 / Komarova (1966) sub nom. *A. subtessulata* var. *efibulata* / *30* / S.

The authentic specimen examined had clampless hyphae, rather dense palisade hymenium, and spores (4) 5–6.5 x 2.5–3.5 µm, typical for the genus *Phanerochaete*.

147. ***Phanerochaete cremeo-ochracea** (Bourdot & Galzin) Hjortstam, Windahlia 17: 58, 1987 / MSK 5120 / 13 Jun 1995 // 13 / S.

The single very scanty specimen does not distinctly differ from *Byssomerulius tuberculatus* (P. Karst) Zmitrovich (syn. *Phanerochaete tuberculata* (P. Karst.) Parmasto), and has spores 5.5–8.5 x 2.5–3 µm.

148. ***Phanerochaete calotricha** (P. Karst.) J. Erikss. & Ryvarden in J. Erikss. *et al.*, Cort. N. Eur. 5: 997, 1978 / MSK 4656 / 19 Feb 1999 // 13 / S.

The specimen has features of *Ph. calotricha*: basidioma moderately pellicular, 0.15–0.3 mm thick, subiculum and subhymenium well developed, moderately dense, and lacking distinct crystals. Regular cystidia are absent and clamps are rare as in *Ph. galactites*. Occasional cystidia are encrusted, *ca* 5 µm wide and up to 17 µm projecting, and easily breaking.

149. **Phanerochaete laevis** (Pers. : Fr.) J. Erikss. & Ryvarden in J. Erikss. *et al.*, Cort. N. Eur. 5: 1007, 1978; *Ph. affinis* (Burt) Parmasto / 4 / 14 Jul 1997 / Komarova (1966) / 10, 13, 23*, 26*, 30* / S.

150. **Phanerochaete sanguinea** (Fr. : Fr.) Pouzar, Česká Mykol. 27 (1): 26, 1973. – *Peniophora sanguinea* (Fr. : Fr.) Bres. / 13 / 10 Oct 1969 / Komarova (1966) / 2*, 10, 13, *21**, 23*, 26, 28 / S, LM.

151. **Phanerochaete sordida** (P. Karst.) J. Erikss. & Ryvarden in J. Erikss. *et al.*, Cort. N. Eur. 5: 1023, 1978; *Ph. cremea* (Bres.) Parmasto / 5 / 14 Aug 1994 / Komarova (1966) / 10, 13, 23*, 26*, *30** / S, LM.

152. **Phanerochaete velutina** (DC. : Fr.) P. Karst., Krit. öfvers. Finl. basidsvamp. Tillägg 3: 33, 1898 / 5 / 10 Oct 1969 / Komarova (1966) / 10, 13, *14*, *21**, 23*, *29**, *30** / S.

153. **Phellodon niger** (Fr. : Fr.) P. Karst., Rev. Mycol. (Toulouse) 3 (9): 19, 1881. – *Hydnum nigrum* Fr. : Fr. – *Ph. niger* (Fr. : Fr.) P. Karst., Meddeland. Soc. Fauna Fl. Fenn. 6: 15, 1881. /// Kuprevich (1931b) / *13** / E.

154. **Phellodon tomentosus** (L. : Fr.) Banker, Mem. Torrey Bot. Club 12 (2): 171, 1906; *Hydnum cyathiforme* Schaeff. ex St-Amans, non *H. cyathiforme* Fr. a et b / 3 / 5 Sep 1962 / Kuprevich (1931b) / 2*, 10, 13, 23*, 26*, 30 / E.

MSK 3608 has morphology transitional to *Ph. confluens* (Pers.) Pouzar: spores 3–4.5 µm diam and not pronounced colour zones on the pileus. In MSK 5740 the abhymenial surface of the pileus is gray-brown with a dirty violaceous tinge, turning greenish-black with KOH.

155. **Phlebia albomellea** (Bondartsev) Nakasone, Mycologia 88 (5): 766, 1996. – *Cytidiella melzeri* Pouzar / MSK 5574 / 17 Jul 1998 / Yurchenko (2001b) / 18 / S.

156. **Phlebia aurea** (Fr. : Fr.) Nakasone, Sydowia 49 (1): 55, 1997; *Sarcodontia stenodon* (Pers.) Nikol. / 2 / 11 Jul 1998 / Komarova (1966) and simultaneously Komarova & Golovko (1966) / 10, 26* / S.

157. **Phlebia centrifuga** P. Karst., Meddeland. Soc. Fauna Fl. Fenn. 6: 10, 1881 / 5 / 20 Oct 1964 / Komarova (1965) / 10, 23* / S.

The general macroscopic shape of the specimens studied is very similar to *Ph. radiata*, but spores are big as in *Ph. centrifuga*, 6.5–8.5 (9.5) × 2.5–3.5 (4) µm.

158. **Phlebia fuscoatra** (Fr. : Fr.) Nakasone, Sydowia 49 (1): 59, 1997. – *Mycoleptodon fuscoater* (Fr. : Fr.) Pilát 'fusco-ater' / 2 / 23 Oct 1963 / *Nikolajeva (1961)*, Komarova & Golovko (1965) / 2*, 4*, 10, 26, 30* / S.

159. **Phlebia radiata** Fr. : Fr., Syst. mycol. 1: 427, 1821; *Ph. aurantiaca* (Sowerby) J. Schröt. / 13 / 22 Dec 1964 / Komarova (1965) / 2, *3*, 10, 13, 23*, 31 / S, B.

160. **Phlebia rufa** (Pers. : Fr.) M.P. Christ., Dansk Bot. Ark. 19 (2): 164, 1960. – *Merulius lividus* Bourdot & Galzin / 2 / 22 Jul 1995 / Komarova (1965) / 10, 30*, 31 / S.

161. ***Phlebia subochracea** (Bres.) J. Erikss. & Ryvarden, Cort. N. Eur. 4: 873, 1976 / MSK 3913 / 24 Sep 1964 / 23 / S.

Phlebia ochraceofulva (Bourdot & Galzin) Donk ('ochraceo-fulva') is possibly conspecific with *Ph. subochracea* (Eriksson *et al.*, 1981: 1145). Komarova (1966) published an earlier record of *Ph. ochraceofulva* for district № 23.

162. **Phlebia subserialis** (Bourdot & Galzin) Donk, Fungus 27: 12, 1957 /// Komarova (1966) / 26* / S.

163. **Phlebia subulata** J. Erikss. & Hjortstam in J. Erikss. *et al.*, Cort. N. Eur. 6: 1175, 1981 / 2 / 12 Nov 1963 / Yurchenko (2000d) / 10, 26 / S.

164. **Phlebia tremellosa** (Schrad. : Fr.) Nakasone & Burds., Mycotaxon 21: 245, 1984 'tremellosus'. – *Merulius tremellosus* Schrad. : Fr. / 10 / 21 Oct 1964 / Wyssotzky *et al.* (1925) / 2, 10, 13, *14*, *17**, 23*, 26, 27*, 30 / S, LM.

165. **Phlebia uda** (Fr. : Fr.) Nakasone, Sydowia 49 (1): 72, 1997. – *Sarcodontia uda* (Fr. : Fr.) Nikol. /// Komarova & Golovko (1966) / 26* / S.

166. **Phlebiella ardosiaca** (Bourdot & Galzin) K.H. Larss. & Hjortstam, Mycotaxon 29: 316, 1987. – *Xenasmatella decipiens* Hjortstam & Ryvarden / MSK 4474 / 11 Jul 1998 / Yurchenko (2000d) / 10 / S, LM.

167. **Phlebiella fibrillosa** (Hallenb.) K.H. Larss. & Hjortstam, Mycotaxon 29: 316, 1987 / 2 / 4 Jun 1999 / Yurchenko (2000d) / 2, 10 / S.

168. **Phlebiella sulphurea** (Pers. : Fr.) Ginns & Lefebvre, Lignic. Cort. N. Amer. 126, 1993. – *Cristella sulphurea* (Pers. : Fr.) Donk; *Trechispora vaga* (Fr. : Fr.) Liberta / 32 / 12 Aug 1956 / Komarova (1966) / 2*, 10, 13, 14, 18, 21, 22, 23*, 26*, 30 / S.

169. **Phlebiopsis gigantea** (Fr. : Fr.) Jülich, Persoonia 10 (1): 137, 1978. – *Phlebia gigantea* (Fr. : Fr.) Donk – *Peniophora gigantea* (Fr. : Fr.) Massee / MSK 3939 / 11 Dec 1986 / Komarova (1966) / 13*, _18*_, 19*, _21_, 23*, _26*_ / S.

170. ***Phlebiopsis ravenelii** (Cooke) Hjortstam, Windahlia 17: 58, 1987. – *Ph. roumeguerii* (Bres.) Jülich & Stalpers – 'roumeguerei' (Parmasto, 1997) / MSK 6157 / 29 May 2002 // *14* / S.

The specimen has spores (3.3) 3.7–5.5(6) × (2.3) 2.8 (3) μm, with heterogeneous protoplasm making them seem thick-walled.

171. **Piloderma byssinum** (P. Karst.) Jülich, Ber. Deutsch. Bot. Ges. 81: 418, 1969. – *Athelia byssina* (P. Karst.) Parmasto / 5 / 4 Jun 1999 / Golovko (1983) / 10, 13, 21 / S, LM.

Analysis of MSK specimens has indicated that the name *A. byssina* was sometimes mistakenly applied to *Amphinema byssoides*.

172. **Piloderma fallax** (Liberta) Stalpers, Stud. Mycol. 24: 53, 1984; *P. croceum* J.Erikss. & Hjortstam / 3 / 23 Sep 1999 / Golovko (1983) / 2, 13 / S, B, LM.

173. **Plicaturopsis crispa** (Pers. : Fr.) D.A. Reid, Persoonia 3 (1): 150, 1964. – *Trogia crispa* (Pers. : Fr.) Fr. – *Plicatura crispa* (Pers. : Fr.) Rea /// Błoński, 1889 – see Serzhanina (1994) / _13*_, _19*_, 23*, 26* / S.

174. **Porostereum spadiceum** (Pers. : Fr.) Hjortstam & Ryvarden, Synopsis Fungorum 4: 51, 1990. – *Lopharia spadicea* (Pers. : Fr.) Boidin /// *Davydkina (1980)* // S.

175. **Porotheleum fimbriatum** Pers. ex Fr., Observ. mycol. 2: 272, 1818 non *Porothelium fimbriatum* Pers. : Fr. (ascolichen sec. Cooke, 1989). – *Stromatoscypha fimbriata* (Pers. : Fr.) Donk, Persoonia 1 (1): 81, 1959, 'fimbriatum' (Bondarceva & Parmasto, 1986) / MSK 3653 / Oct 1954 / Komarova (1964) / 4*, 10*, 23*, 30 / S.

176. **Pseudotomentella tristis** (P. Karst.) M.J. Larsen, Nova Hedwigia 22: 613, 1972 /// Kõljalg (1996) / _23*_ / S.

177. **Pterula multifida** E.P. Fr. ex Fr., Linnaea 5: 531, 1830 non ss. auct. /// Parmasto (1965) // S.

178. **Punctularia strigosozonata** (Schwein.) P.H.B. Talbot, Bothalia 7 (1): 143, 1958 'strigoso-zonata'. – *Phaeophlebia strigosozonata* (Schwein.)

W.B. Cooke / 5 / 22 Aug 1963 / Komarova (1966) / 18, *19**, 21, 23, *29**, *30*, 30* / S, LF.

179. **Radulomyces confluens** (Fr. : Fr.) M.P. Christ., Dansk Bot. Ark. 19 (2): 230, 1960 / 47 / 27 Dec 1992 / Yurchenko (1998b) / *3*, 10, 13, 20, 24, 30, 31 / S.

180. **Radulomyces molaris** (Chaillet ex Fr. : Fr.) M.P. Christ., Dansk Bot. Ark. 19 (2): 232, 1960; *Radulum rude* (Pers.) S. Lundell / 5 / 22 Aug 1963 / *Nikolajeva (1961)*, Komarova (1966) / 23, 30, 31, *30** / S.

181. **Ramaria abietina** (Pers. : Fr.) Quél., Fl. mycol. France 463, 1888. – *Clavaria abietina* Pers. non Fr.; *R. ochraceovirens* (Jungh.) Donk 'ochraceo-virens' /// Lebedeva (1925b) / *13**, 26* / S.

182. **Ramaria aurea** (Schaeff. : Fr.) Quél., Fl. mycol. France 467, 1888. – *Clavaria aurea* Schaeff. : Fr. /// Kuprevich (1931a) / *13** / (S).

183. **Ramaria botrytis** (Pers. : Fr.) Ricken, Vadem. Pilzfr. 253, 1918. – *Clavaria botrytis* Pers. : Fr. / Kuprevich (1931a) / 13* / (S).

184. ***Ramaria bourdotiana** Maire, Fungi Catal. 2: 32, 1937 / MSK 5691 / 9 Sep 2000 // 13 / S.

185. ***Ramaria corrugata** (P. Karst.) Schild, Schweiz. Z. Pilzk. 53: 130, 1975 non ss. Schild / MSK 3833 / 7 Sep 1987 // 13 / (S).

186. **Ramaria eumorpha** (P. Karst.) Corner, Ann. Bot. Mem. 1: 575, 1950; *Clavaria abietina* Pers. : Fr. ss. Fr.; *R. invalii* (Cotton & Wakef.) Donk / 14 / 8 Aug 1960 / *Parmasto (1965)*, Serzhanina & Zmitrovich (1986) and simultaneously Serzhanina & Yashkin (1986) / 13, *14*, 21, *25*, 26, 30 / S.

187. **Ramaria flava** (Schaeff. : Fr.) Quél., Fl. mycol. France 466, 1888. – *Clavaria flava* Schaeff. : Fr. /// Kuprevich (1931a) / 13*, *20**, 23* / (S).

188. ***Ramaria flavobrunnescens** (G.F. Atk.) Corner, Ann. Bot. Mem. 1: 581, 1950 'flavo-brunnescens' / MSK 3853 / 28 Sep 1986 // 13 / S.

189. **Ramaria formosa** (Pers. : Fr.) Quél., Fl. mycol. France 466, 1888 non ss. Corner – *Clavaria formosa* Pers. : Fr. /// Kuprevich (1931a) / *13** / (S).

190. **Ramaria gracilis** (Pers. : Fr.) Quél., Fl. mycol. France 463, 1888. – *Clavaria gracilis* Pers. : Fr. /// Kuprevich (1931a) / *13** / (S).

191. **Ramaria stricta** (Pers. : Fr.) Quél., Fl. mycol. France 464, 1888 /// *Parmasto (1965)* // S.

192. ***Ramaria testaceoflava** (Bres.) Corner, Ann. Bot. Mem. 1: 630, 1950 / MSK 3837 / 7 Sep 1974 // 13 / (S).

193. **Ramaricium albo-ochraceum** (Bres.) Jülich, Persoonia 9 (3): 417, 1977 / MSK 4744 / 3 Jun 1999 / Yurchenko (2000d) / 10 / S.

194. **Ramariopsis crocea** (Pers. : Fr.) Corner, Ann. Bot. Mem. 1: 638, 1950. – *Clavaria crocea* Pers. : Fr. /// Kuprevich (1931a) / *13** / S.

195. **Resinicium bicolor** (Alb. & Schwein. : Fr.) Parmasto, Consp. syst. Cortic. 98, 1968. – *Odontia bicolor* (Alb. & Schwein. : Fr.) Quél. / 11 / 21 Nov 1963 / Komarova (1966) and simultaneously Komarova & Golovko (1966) / 10, 13, 14, 23, 26, *30** / S.

196. **Sarcodon glaucopus** Maas Geest. & Nannf., Svensk Bot. Tidskr. 63: 407, 1969; *S. amarescens* (Quél.) Quél. nom. conf. sec. Maas Geest., Fungus 26: 47, 1956 /// Komarova & Golovko (1965) / 2*, 10* / E.

197. **Sarcodon imbricatus** (L. : Fr.) P. Karst., Rev. Mycol. (Toulouse) 3 (9): 20, 1881 'imbricatum'. – *Hydnum imbricatum* L. : Fr. – *S. imbricatus* (L. : Fr.) P. Karst., Meddeland. Soc. Fauna Fl. Fenn. 6: 16, 1881. / 3 / 28 Sep 1960 / Kuprevich (1931a) / 19, *21*, 23 – for *S. imbricatus* s. str.; 2*, 10*, *13**, 19*, *20**, 23* – for *S. imbricatus* s. l. (see *S. squamosus*) / E.

198. **Sarcodon leucopus** (Pers.) Maas Geest. & Nannf., Svensk Bot. Tidskr. 63: 415, 1969; *Hydnum laevigatum* Sw. non Fr., nom. conf. sec. Maas Geesteranus (1975) /// Kuprevich (1931a) sub nom. *H. laevigatum* / *13** / E.

199. ***Sarcodon squamosus** (Schaeff.) Quél., Enchir. fung. 188, 1886; *Hydnum badium* Pers. (nom. illeg.), non *H. badium* Pers. ss. auct. / 3 / 1972 // 11, 26 / E.

This species, peculiar to pine forests, was obviously regarded as *S. imbricatus* by earlier investigators in Belarus. Separation into two species based on pigments and macroscopic form was carried out by Johannesson *et al*. (1999).

200. **Sarcodontia crocea** (Schwein. : Fr.) Kotl., Česká Mykol. 7: 117, 1953; *Sarcodontia setosa* (Pers.) Donk / 2 / 8 Sep 1994 / Yurchenko (1998a) / 13, 25 / P, S.

201. **Schizophyllum amplum** (Lév.) Nakasone, Mycologia 85 (5): 771, 1996. – *Auriculariopsis ampla* (Lév.) Maire / 2 / 18 Oct 1990 / Komarova (1966) / 10, 13, 30* / S.

202. **Schizophyllum commune** Fr. Fr., Syst. mycol. 1: 330, 1821. – *Sch. alneum* J. Schröt. / 25 / 10 Aug 1950 / Wyssotzky *et al*. (1925) / 3, 10, 13, 26, *27*, 30, *32* / S, P.

203. **Schizopora paradoxa** (Schrad. : Fr.) Donk, Persoonia 5 (1): 104, 1967; *Irpex obliquus* (Schrad. : Fr.) Fr.; *Xylodon versiporus* (Pers.) Bondartsev p.p. / 11 / 21 Oct 1963 / Lebedeva (1925b) / 12, 13, 23, 26, 30 – for *Sch. paradoxa* and *I. obliquus*; 10*, 23*, 26* – for *X. versiporus* / S.

204. **Schizopora radula** (Pers. : Fr.) Hallenb., Mycotaxon 18 (2): 308, 1983. – *Hyphodontia radula* (Pers. : Fr.) E. Langer & Vesterholt – *Xylodon versiporus* (Pers.) Bondartsev p.p. / 8 / 22 Aug 1963 / Bondartsev (1953) sub nom. *X. versiporus*, Yurchenko (2000a) / 10, *30*, *31* / S.

205. **Scopuloides hydnoides** (Cooke & Massee) Hjortstam & Ryvarden, Mycotaxon 9 (2): 509, 1979. Jülich – *Phlebia hydnoides* (Cooke & Massee) M.P. Christ.; *S. rimosa* (Cooke) / 10 / 14 Jul 1997 / Komarova (1966) / 10, 26* / S, LM.

Scopuloides rimosa is synonymized with *S. hydnoides* following Burdsall (1985).

206. **Scytinostroma galactinum** (Fr.) Donk, Fungus 26: 20, 1956 / 7 / 14 Aug 1956 / Komarova (1966) / 10, 19, 23, 29, 30 / S.

207. **Scytinostroma odoratum** (Fr. : Fr.) Donk, Fungus 26: 20, 1956 / 5 / 31 Jul 1958 / Komarova (1966) / 10, 26*, 30 / S.

208. **Serpula aurea** (Fr. : Fr.) P. Karst., Bidrag Kännedom Finlands Natur Folk 48: 344, 1889. – *Merulius aureus* Fr. : Fr. – *Pseudomerulius aureus* (Fr. : Fr.) Jülich / 5 / 20 Oct 1964 / Komarova (1965) / 10, 13* / S.

209. **Serpula himantioides** (Fr. : Fr.) P. Karst., Bidrag Kännedom Finlands Natur Folk 48: 343, 1889 / MSK 3760 / 10 Sep 1969 / Komarova (1965) / 2*, 10, 23* / S.

210. **Serpula lacrymans** (Wulfen in Jacq. : Fr.) J. Schröt. in Cohn, Krypt.-Fl. Schles. 3 (1): 466, 1888. – 'lacrimans' (Parmasto, 1997). – *Merulius lacrymans* Wulfen : Fr. / 2 / Sep 1963 / Dorogin, 1912 – see Golovko (1981) / *7**, 10, 13*, 26*, 28* / S.

211. **Serpula mollusca** (Fr. : Fr.) P. Karst., Bidrag Kännedom Finlands Natur Folk 48: 334, 1889. – *Leucogyrophana mollusca* (Fr. : Fr.) Pouzar; *Merulius pseudomolluscus* Parmasto / 2 / 14 Sep 1957 / Komarova (1965) / *2*, 2*, *10**, *13**, 23 / S.

212. **Serpula sororia** (Burt) Zmitrovich, Nov. Syst. Pl. non Vasc. 35: 83, 2001. – *Leucogyrophana sororia* (Burt) Ginns / MSK 3989 / 21 Oct 1964 / Yurchenko (1998c) / 10 / S.

213. **Serpulomyces borealis** (Romell) Zmitrovich in Zmitrovich & Spirin, Mikol. Fitopatol. 36 (1): 20, 2002. – *Ceraceomyces borealis* (Romell) J. Erikss. & Ryvarden / 2 / 19 Aug 1963 / Yurchenko (2000d) sub nom. *C.* aff. *borealis*, Yurchenko (2001a) / 10, *30* / S.

MSK 3920 has very narrow, curved spores tapering to the apiculus, 3.5–6.3 × 1–2 µm.

214. **Sistotrema brinkmannii** (Bres.) J. Erikss., Förh. Kungl. Fysiogr. Sällsk. 18 (8): 17, 1948 / 14 / 21 Oct 1964 / Komarova (1966) / 10, 11, 13, *14*, 19, 31, *30** / S, LF.

In MSK 4420 spores are ellipsoid to short cylindrical, 3–5.5 × 2–2.2 (2.5) µm, very weak or not concave at the adaxial side. MSK 4803 has a cream hymenial surface and spores 3–4.5 (5.2) × 1.5–2.5 µm.

215. **Sistotrema confluens** Pers. : Fr., Syst. mycol. 1: 426, 1821 /// Kuprevich (1931b) / *13** / (S).

216. **Sistotrema oblongisporum** M.P. Christ. & Hauerslev, Dansk Bot. Ark. 19 (2): 82, 1960 / 5 / 11 Aug 1994 / Yurchenko (1998b) / 10, 13, 28 / S.

217. **Sistotrema octosporum** (J. Schröt. ex Höhn. & Litsch.) Hallenb. in J. Erikss. *et al.*, Cort. N. Eur. 7: 1349, 1984 / MSK 4342 / 14 Nov 1997 / Yurchenko (1998c) / 10 / S.

218. **Sistotrema raduloides** (P. Karst.) Donk, Fungus 26: 4, 1956 / 8 / 28 Aug 1957 / Komarova & Golovko (1965) / 19, 26, *29**, 30 / S.

219. ***Sistotremastrum niveocremeum** (Höhn. & Litsch.) J. Erikss., Symb. Bot. Upsal. 16 (1): 62, 1958. – *Sistotrema niveocremeum* (Höhn. & Litsch.) J. Erikss. / 3 / 13 Nov 1997 // 10 / S.

220. **Sistotremastrum suecicum** Litsch. ex J. Erikss., Symb. Bot. Upsal. 16 (1): 62, 1958 / 9 / 28 May 1997 / Yurchenko (1998b) / 10 / S.

221. **Sparassis brevipes** Krombh., Nat. Abbild. Besch. Schw. 22: 4, 1834; *S. laminosa* Fr.; *S. crispa* var. *laminosa* (Fr.) Quél. /// Vynaev & Gapienko (2002) /// 20* / P.

222. **Sparassis crispa** Wulfen : Fr., Syst. mycol. 1: 465, 1821 / 3 / 27 Aug 1967 / Tumiłowiczówna (1935) / 10*, 13, *20**, 21, 23, 26*, *29**, 30*, *32** / S, RD, P.

223. **Steccherinum ciliolatum** (Berk. & M.A. Curtis) Gilb. & Budington, J. Arizona Acad. Sci. 6 (2): 97, 1970; *S. litschaueri* (Bourdot & Galzin) J. Erikss. / MSK 3945 / 21 Sep 1963 / Yurchenko (2000d) / 26 / S.

224. **Steccherinum fimbriatum** (Pers. : Fr.) J. Erikss., Symb. Bot. Upsal. 16 (1): 134, 1958. – *Mycoleptodon fimbriatus* (Pers. : Fr.) Bourdot & Galzin / 8 / 14 Jul 1997 / Błoński, 1889 – see Komarova & Golovko (1965) / 10, 13, 23, 26*; 30* / S, LM.

225. **Steccherinum ochraceum** (Pers. ex J.F. Gmel. : Fr.) Gray, Nat. arr. Br. pl. 1: 651, 1821. – *Mycoleptodon ochraceus* (Pers. ex J.F. Gmel. : Fr.) Pat. / 2 / 9 Nov 1962 / *Nikolajeva (1961)*, Komarova & Golovko (1965) / 10, *13**, 23*, 26*, 28 / S.

MSK 8000 has almost effuse basidiomata with teeth 0.35–0.4 mm long and small spores, 2.7–3.3 × 1.3–1.5 µm.

226. **Steccherinum queletii** (Bourdot & Galzin) Hallenb. & Hjortstam, Mycotaxon 31 (2): 443, 1988. – *Odontia queletii* Bourdot & Galzin /// Komarova & Golovko (1966) / 26* / S.

227. **Steccherinum subcrinale** (Peck) Ryvarden, Norweg. J. Bot. 25: 294, 1978; *Mycoleptodon kavinae* Pilát, sec. Jülich (1984) /// *Nikolajeva (1961)* // S.

228. **Stereum gausapatum** (Fr. : Fr.) Fr., Hymenomyc. Eur. 638, 1874 / MSK 3922 / 28 Aug 1978 / *Davydkina (1980)*, Golovko (1988) / *13**, 30 / S.

229. **Stereum hirsutum** (Willd. : Fr.) Gray, Nat. arr. Br. pl. 1: 653, 1821 / 40 / Oct 1958 / Lebedeva (1925a) and simultaneously Wyssotzky *et al.* (1925) / 2, 10, 13, *14*, 23, 25, 26, 30, 31, 32* / S, P.

Records of *S. complicatum* (Fr. : Fr.) Fr. in Golovko (1988) evidently belong to *S. hirsutum*, which has flabelliform undulate basidiomata.

230. **Stereum rugosum** (Pers. : Fr.) Fr., Epicr. syst. mycol. 552, 1838. – *Haematostereum rugosum* (Pers. : Fr.) Pouzar / 34 / 9 Sep 1962 / Lebedeva (1925a) / 10, 12, 13, *14*, 21, 23, 26, 30* / S, RD.

231. **Stereum sanguinolentum** (Alb. & Schwein. : Fr.) Fr., Epicr. syst. mycol. 549, 1838. – *Haematostereum sanguinolentum* (Alb. & Schwein. : Fr.) Pouzar / 5 / 11 Jul 1998 / Lebedeva (1925b) / 10, 13, 14, 19*, 26 / S, RD.

232. **Stereum subtomentosum** Pouzar, Česká Mykol. 18 (3): 147, 1964. – *Stereum fasciatum* (Schwein.) Fr. sensu auct. florae Europ., sec. Pouzar (1964) / 5 / 9 Oct 1969 / Komarova *et al.* (1968) / 2*, 10, *13**, 23*, 26* / S, LM.

233. **Subulicystidium longisporum** (Pat.) Parmasto, Consp. syst. Cortic. 121, 1968 / 7 / 2 Jun 1999 / Yurchenko (2000d) / 10 / S.

234. **Thanatephorus cucumeris** (A.B. Frank) Donk, Reinwardtia 3 (3): 376, 1956; *Hypochnus solani* Prill. & Delacr. – *Rhizoctonia solani* J.G. Kühn nom. anam. /// Chekalinskaya (1958) / probably over all area / P.

235. ***Thelephora** aff. **albidobrunnea** Schwein., Trans. Amer. Philos. Soc. II, 4: 166, 1832 / MSK 3725 / 6 Sep 1977 // *27* / (S). 4: 167

This uncommon find has flabelliform, semi-orbicular or almost orbicular, fleshy-coriaceous basidiomata consisting of radial spathuliform lobes curved to the ground, combined in a common "stipe" *ca* 1 × 1 cm; with lobes arranged in an indistinct imbricate pattern, confluent laterally or upper with lower, 1–1.5 mm thick when dry; upper surface with abhymenial tomentum, cream, ochraceous towards the base; lower surface chocolate brown or cream near a lobe tip; hymenium almost unilateral – mostly underside the lobes; hyphae subhyaline, 3.3–6.5 µm wide; basidia 55–65 × 7.5–10 µm; spores irregular, angular to lobed, 6–10.5 × 5.5–7 µm, with echinuli 0.8–1.5 µm long.

236. ***Thelephora anthocephala** Bull. : Fr., Epicr. syst. mycol. 355, 1838 / 2 / 3 / 30 Aug 1966 // 13, 21 / E.

237. **Thelephora caryophyllea** Schaeff. : Fr., Syst. mycol. 1: 430, 1821; – *Th. radiata* Fr. / 2 / 15 Aug 1956 / Komarova (1966) / 13, 30 / (S).

238. **Thelephora palmata** Scop. : Fr., Syst. mycol. 1: 432, 1821 / 10 / 8 Aug 1960 / Kuprevich (1931b) / 13, 20*, 21, *25* / E.

239. **Thelephora terrestris** Ehrh. : Fr., Syst. mycol. 1: 432, 1821 / 10 / 5 Sep 1962 / Lebedeva (1925b) / 2*, 10, 13*, 18, 19, 20, 26*, *27*, 30*, 32* / S, P, B, LM, (S).

This species has two striking forms: f. *terrestris* and f. *resupinata*; the resupinate form is treated in handbooks together with tomentelloid fungi, as in Jülich & Stalpers (1980). However, clear distinction of the two forms is not always possible because of variability in basidioma margin morphology.

f. **resupinata** Donk, Rev. Niederl. Homob. Aphyll. 2: 44, 1933 / 7 / 5 Sep 1962 / Yurchenko (2000a) / 10, 19, 20 / S, B, LM.

240. **Tomentella atramentaria** Rostr., Bot. Tidsskr. 19: 41, 1894 / 2 / 2 May 1994 / Yurchenko (2000d) / 10, 30 / S.

241. **Tomentella badia** (Link) Stalpers, Rev. Mycol. (Paris) 29: 98, 1957 / 2 / 4 Jun 1999 / Kõljalg (1996) / 10, *23** / S.

242. **Tomentella bryophila** (Pers. : Fr.) M.J. Larsen, Mycol. Mem. 4: 51, 1974; *T. pallidofulva* (Peck) Litsch. 'pallido-fulva' /// Komarova (1966) / *23**, 26* / S.

243. **Tomentella cinerascens** (P. Karst.) Höhn. & Litsch., Sitzungsber. K. Akad. Wiss. Wien, Math.-nat. Kl. I 115: 1570, 1906 /// Kõljalg (1996) / *23** / S.

244. **Tomentella cinereoumbrina** (Bres.) Stalpers, Stud. Mycol. 35: 96, 1993 / 3 / 2 Jun 1999 / Yurchenko (2000d) / 10, 21 / S.

245. **Tomentella coerulea** (Bres.) Höhn. & Litsch., Sitzungsber. K. Akad. Wiss. Wien, Math.-nat. Kl. I 116: 831, 1907 / 4 / 21 Oct 1964 / Yurchenko (2000d) / 10, 23 / S.

246. **Tomentella crinalis** (Fr.) M.J. Larsen, Taxon 16: 511, 1967 / 2 / 16 Sep 1956 / Yurchenko (2000d) / 4, 23 / S.

247. **Tomentella ellisii** (Sacc.) Jülich & Stalpers, Verh. Kon. Ned. Akad. Wetensch., Afd. Natuurk. II 74: 236, 1980 /// Kõljalg (1996) / *23** / S.

248. **Tomentella ferruginea** (Pers. : Fr.) Pat., Hym. Europ. 154, 1887 /// Kõljalg (1996) / *23** / S.

249. **Tomentella fuscocinerea** (Pers.) Donk, Med. Bot. Mus. Herb. Rijks-Univ. Utrecht 9: 30, 1933 / 4 / 3 Jun 1999 / Yurchenko (2000d) / 10, 21 / S, LM.

250. **Tomentella galzinii** Bourdot in Bourdot & Galzin, Bull. Soc. Mycol. France 40: 143, 1924 / 2 / 15 Jul 1997 / Yurchenko (2000a) / 10 / S.

251. **Tomentella lapida** (Pers.) Stalpers, Stud. Mycol. 24: 65, 1984 / 14 / 21 Oct 1964 / Kõljalg (1996) / 10, 21, *23** / S, LM.

252. **Tomentella lateritia** Pat., J. Bot. (Morot) 8: 221, 1894 / MSK 3947 / 23 Sep 1963 / Yurchenko (2000d) / 26 / S.

253. **Tomentella lilacinogrisea** Wakef., Trans. Brit. Mycol. Soc. 49: 360, 1966 /// Kõljalg (1996) / *23** / S.

254. **Tomentella punicea** (Alb. & Schwein. : Fr.) J. Schröt. in Cohn, Krypt.-Fl. Schles. 3 (1): 420, 1888; *T. griseoviolacea* Litsch. / 9 / 14 Jul 1997 / Kõljalg (1996) / 10, *23** / S, LM.

255. ***Tomentella radiosa** (P. Karst.) Rick, Brotéria Ci. Nat. 3: 79, 1934 / 3 / 5 Jun 1999 // 10 / S.

Kõljalg *et al.* (2000) indicate that, on the basis of molecular data, *T. radiosa* is supposedly a resupinate form of *Thelephora terrestris* basidiomata.

256. **Tomentella stuposa** (Link) Stalpers, Stud. Mycol. 24: 86, 1984 / 2 / 3 Jun 1999 / Yurchenko (2000d) / 10 / S.

257. **Tomentella sublilacina** (Ellis & Holw.) Wakef., Mycologia 52: 931, 1960 / 2 / 14 Jul 1997 / Kõljalg (1996) / 10, *23** / S.

258. **Tomentella subtestacea** Bourdot & Galzin, Bull. Soc. Mycol. France 40: 144, 1924 /// Kõljalg (1996) / *23** / S.

259. **Tomentella terrestris** (Berk. & Broome) M.J. Larsen, Mycol. Mem. 4: 105, 1974 / 3 / 4 Jun 1999 / Yurchenko (2000d) / 10, 13 / S, LM.

260. **Tomentellopsis echinospora** (Ellis) Hjortstam, Svensk Bot. Tidskr. 64 (4): 426, 1970 / 3 / 21 Sep 2001 / Kõljalg, 1996 / 13, *23** / S, LM.

261. **Trechispora byssinella** (Burdot) Liberta, Taxon 15 (8): 318, 1966 / MSK 4362 / 14 Nov 1997 / Yurchenko (1998c) / 10 / S.

262. **Trechispora farinacea** (Pers. : Fr.) Liberta, Taxon 15 (8): 318, 1966. – *Cristella farinacea* (Pers. : Fr.) Donk / 5 / 3 Jun 1999 / Komarova (1966) / 10, 30* / S, LM.

263. **Trechispora microspora** (P. Karst.) Liberta, Taxon 15 (8): 319, 1966. – *Cristella microspora* (P. Karst.) Parmasto / 21 / 21 Oct 1964 / Komarova (1966) / 10, 12, 13, 14, 18, 19*, 26 / S, LM.

264. **Trechispora nivea** (Pers. : Fr.) K.H. Larss., Symb. Bot. Upsal. 30: 110, 1995. – *Grandinia nivea* (Pers. : Fr.) S. Lundell /// Komarova & Golovko (1966) / 26*, *30** / S.

265. **Trechispora subsphaerospora** (Litsch.) Liberta, Canad. J. Bot. 51 (10): 1887, 1973 / 4 / 3 Jun 1999 / Yurchenko (2001a) / 10 / S.

266. **Tubulicrinis angustus** (D.P. Rogers & Weresub) Donk, Fungus 26: 14, 1956 / 2 / 10 Jul 1998 / Yurchenko (2000a) sub nom. *T.* aff. *angustus*, Yurchenko (2001c) / 10, 14 / S.

MSK 4453 has cystidia up to 7.5 μm wide, short basidia, 13.5–17 μm, and short spores, 5–6.5 (11) μm. In MSK 6083 cystidia 5–7.5 (9.2) μm wide, spores 6–7 μm long.

267. **Tubulicrinis glebulosus** (Fr.) Donk, Fungus 26: 14, 1956. – *Peniophora glebulosa* (Fr.) Sacc. & Syd. / 9 / 5 Sep 1962 / Lebedeva (1925b) / 10, 13, 26*, 30* / S.

268. **Tubulicrinis subulatus** (Bourdot & Galzin) Donk, Fungus 26: 14, 1956 / 18 / 28 May 1997 / Yurchenko (1998b) / 10, 12, 23 / S, LM.

269. ***Tulasnella intrusa** Hauerslev, Op. bot. Soc. bot. Lund 100: 114, 1989 / MSK 4435 / 11 Jul 1998 // 10 / P.

A badly known species, found parasitizing a basidioma of *Botryobasidium subcoronatum*.

270. ***Tulasnella pruinosa** Bourdot & Galzin, Bull. Soc. Mycol. France 39: 264, 1923 / 2 / 24 Sep 1999 // *1*, 10 / S.

271. ***Tulasnella violea** (Quél.) Bourdot & Galzin, Bull. Soc. Mycol. France 25 (1): 31, 1909 / 4 / 3 Jun 1999 // 10, 26 / S, B, LM.

272. **Tylospora fibrillosa** (Burt) Donk, Taxon 9: 220, 1960 / 5 / 3 Jun 1999 / Yurchenko (2000d) / 10 / S, LM.

273. ***Typhula anceps** P. Karst., Bidrag Kännedom Finlands Natur Folk 48: 386, 1889 / MSK 3694 / 10 Sep 2000 // 31 / S.

274. ***Typhula erythropus** (Pers. : Fr.) Fr., Syst. mycol. 1: 495, 1821 / 2 / 23 Sep 2000 // 13 / S.

275. **Typhula incarnata** Lasch : Fr., Epicr. syst. mycol. 585, 1838 /// Chekalinskaya (1986) // P.

276. **Typhula trifolii** Rostr. in Lind, Dan. Fungi Herb. Rostrup 365, 1913 /// Dorozhkin *et al.* (1978) // P.

277. **Uthatobasidium fusisporum** (J. Schröt.) Donk, Fungus 28: 22, 1958 / 3 / 21 Oct 1964 / Yurchenko (2000d) / 10, 13, *14* / S, LM.

278. **Vararia investiens** (Schwein.) P. Karst., Bidrag Kännedom Finlands Natur Folk 62: 96, 1903 /// *Bondarceva & Parmasto (1986)* // S.

279. ***Vuilleminia alni** Boidin, Lanquetin & Gilles, Bull. Soc. Mycol. France 110 (2): 95, 1994 / 2 / 7 Nov 1997 // 13, *31* / S.

280. **Vuilleminia comedens** (Nees : Fr.) Maire, Bull. Soc. Mycol. France 18 (Suppl.): 81, 1902 / 10 / 1 May 1996 / Komarova *et al.* (1968) / 10, 13, 23*, 24, 30 / S, RD.

281. **Xylobolus frustulatus** (Pers. : Fr.) Boidin, Rev. Mycol. (Paris) 23: 341, 1958. – *Stereum frustulosum* Pers. : Fr. – *S. frustulatum* (Pers. : Fr.)

Fuckel / 16 / 27 Aug 1957 / Lebedeva (1925b) / 13*, 19, 23, 26, *29**, 30 / S, P.

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ADDITIONAL NOTES AND NEW RECORDS ON THE LICHEN GENUS HYPOTRACHYNA (PARMELIACEAE) FROM INDIA

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ABSTRACT

An enumeration of 37 species of *Hypotrachyna* known from India is provided. *H. boquetensis, H. intercalanda, H. kingii, H. livida* and *H. sinuosa* are new records for India. *H. coorgiana* is reduced to a synonym of *H. boquetensis*. The earlier reports of *H. pseudosinuosa* and *H. sublaevigata* from India belong to *H. radiculata* and *H. boquetensis* respectively.

Key words: Lichens, new records, key

INTRODUCTION

The American tropical species of lichen genus *Hypotrachyna* (Vain.) Hale, a segregate of *Parmelia* Ach. *sensu lato*, was monographed by Hale (1975). The genus is characterized by sublinear, narrow, eciliate, truncate lobe apices, dichotomously branched rhizines, laminal, imperforate apothecia, simple, hyaline, oval-ellipsoid spores and colourless, bifusiform conidia.

The genus comprises ca. 150 species in world (Elix 1994), out of which Awasthi (2000) enumerated the presence of 36 species from Indian subcontinent. Kurokawa (1986) synonymized *H. bostrychodes* (Zahlbr.) Hale, *H. massartii* (Hue) Hale and *H. scytodes* (Kurok.) Hale with *H. physcioides* (Nyl.) Hale, and *H. orientalis* (Hale) Hale with *H. imbricatula* (Zahlbr.) Hale. Wolseley et al. (2002) recognized *H. orientalis* (Hale) Hale and *H. scytodes* (Kurok.) Hale as two distinct taxa and reported them from India. They also reported *H. adjuncta* (Hale) Hale for India but reduces *H. exsecta* (Taylor) Hale in its synonymy. Divakar et al. (2001) describes *H. neosingularis* Divakar, Upreti & Elix from India. In the present study *H. coorgiana* Patw. & A.V. Prabhu, is synonymized with *H. boquetensis* (Hale) Hale. *H. pseudosinuosa* (Asah.) Hale and *H. sublaevigata* (Nyl.) Hale is excluded from India as the reported specimens of these species belong to *H. radiculata* (Kurok.) Elix and *H. boquetensis* (Hale) Hale respectively. Thus the number of *Hypotrachyna* as reported by Awasthi (2000) are reduced to 29. Five additional taxa have been discovered as a new records for Indian lichen flora, are described below in detail to facilitate their easy identification, along with a key and complete list of *Hypotrachyna* species known from India.

MATERIALS AND METHODS

The present study is based on the investigation of herbarium specimens which belong to Botany Department, Lucknow University, Lucknow (LWG-LWU); personal herbarium of Dr. D.D. Awasthi (LWG-AWAS) and other specimens lodged at lichen herbarium, National Botanical Research Institute (LWG). Chemical constituents were identified by thin layer chromatography (Culberson 1972; Walker and James 1980).

Key to Indian *Hypotrachyna* species

1.	Thallus isidiate	2
1a.	Thallus lacking isidia	17
2.	Thallus yellow-green (usnic acid present	*H. microblasta* (Vain.) Hale
2a.	Thallus grey, ashy-gray, usnic acid absent	3
3.	Isidia inflated, dactylate, breaking at top into powdery mass, but soredia not formed	4
3a.	Isidia cylindrical, lobulate or lacinulate, never dactylate	7
4.	Medulla K-, physodic acid present	*H. dactylifera* (Vain.) Hale
4a.	Medulla K+ yellow or red, physodic acid absent	5
5.	Medulla K+ yellow, stictic acid complex present	*H. thryptica* (Hale) Hale
5a.	Medulla K+ red, stictic acid complex absent	6
6.	Only salazinic acid	*H. dodapetta* Hale & Patw.
6a.	Norstictic acid (major) and salazinic acid (in trace)	*H. kingii* (Hale) Hale
7.	Medulla K+ yellow or red	8
7a.	Medulla K-	10
8	Medulla K+ yellow, stictic acid present	*H. crenata* (Kurok.) Hale
8a.	Medulla K+ red, salazinic or norstictic acid present	9
9.	Salazinic and norstictic acid present, lobes subrotund, 5-10 mm wide	*H. awasthii* Hale & Patw.
9a.	Only norstictic acid present, lobes sublinear, 2-6 mm wide	*H. rhabdiformis* (Kurok.) Hale
10.	Medulla P+ orange-red, protocetraric acid present	*H. koyaensis* (Asah.) Hale
10a.	Medulla P-	11
11.	Medulla C+ red, gyrophoric acid present	12
11a.	Medulla C-	13
12.	Gyrophoric and protolichesterinic acid present, lobes, 3-5 mm wide	*H. incognita* (Kurok.) Hale
12a.	Only gyrophoric acid present, lobes 1-3 mm wide	*H. neodissecta* (Hale) Hale
13.	Medulla KC+ orange or rose, barbatic acid present	14
13a.	Medulla KC-, protolichesterinic and caperatic acid present	15
14.	Upper surface strongly white maculate, apothecia 2-10 mm diam., spores (8-) 11-16 x (5-) 7-10 µm	*H. imbricatula* (Zahlbr.) Hale
14a.	Upper surface emaculate, apthecia 2-3 mm diam., spores 9-12 x 4-6 µm	*H. orientalis* (Hale) Hale
14.	Upper surface maculate, rhizines forming a thick mat, apothecia rare, spores 8-10 x 4-6 µm	*H. costaricensis* (Nyl.) Hale
15a.	Upper surface emaculate, rhizines sparse to absent in marginal zone, apothecia common	16

16. Spores 15-19 x 9-11 µm, isidia cylindrical *H. infirma* (Kurok.) Hale

16a. Spores 8-9 x 4.5-5.5 µm, isidia absent but lobules present, dense in centre *H. neosingularis* Divakar, Upreti & Elix

17. Thallus pustulate-sorediate or sorediate 18

17a. Thallus lacknig pustules and soredia 27

18. Thallus greenish yellow (usnic acid present) *H. sinuosa* (Smith) Hale

18a. Thallus gray (usnic acid absent) 19

19. Medulla yellow, yellow-ochraceous either throughout or in parts .20

19a. Medulla white 22

20. Medulla uniformly yellow, upper surface white maculate, barbatic and obtusatic acid present *H. endochlora* (Leighton) Hale

20a. Medulla partially yellow only below soralia, upper surface emaculate, barbatic acid absent 21

21. Thallus UV+ yellow, lichexanthone present *H. osseoalba* (Vain.) Y.S. Park & Hale

21a. Thallus UV-, lichexanthone absent *H. immaculata* (Kurok.) Hale

22. Medulla K+ red, salazinic acid present 23

22a. Medulla K-, salazinic acid absent 24

23. Cilia present, salazinic acid and zeorin *H. radiculata* (Kurok.) Elix

23a. Cilia absent, only salazinic acid. *H. brevirhiza* (Kurok.) Hale

24. Medulla C+ red, soralia distinct, generaly terminal or subterminal, soredia powdery 25

24a. Medulla C-, soralia laminal towards the centre of thallus, pustulate with sparse, coars soredia 26

25. Thallus 2-8 cm across, emaculate, sorediate, lobes revolute, rather fragile, apothecia rare, gyrophoric acid present *H. revoluta* (Flörke) Hale

25a. Thallus 5-12 cm across, white maculate, apothecia 2-8 mm in diam., lecanoric and evernic acid present *H. rockii* (Zahlbr.) Hale

26. Thallus UV+ yellow, lichexanthone present, medulla KC+ red, lividic acid group present, medulla yellow below soralia, K+ purple *H. osseoalba* (Vain.) Y.S. Park & Hale

26a. Thallus UV-, medulla KC+ red, barbatic acid present......*H. adjuncta* (Hale) Hale

27. Medulla K+ red 28

27a. Medulla K- 29

28. Only salazinic acid present, lobes involute, upto 3 mm wide, apothecia 3-8 mm in diameter *H. boquetensis* (Hale) Hale

28a. Salazinic and norstictic acid present, lobes linear, upto 2 mm wide, rhizines moderately branched, apothecia rare *H. mason-halei* Patw. & A.V. Prabhu

29. Medulla yellow-ochraceous *H. rigidula* (Kurok.) Hale

29a. Medulla white 30

30. Medulla P+ orange 31

30a. Medulla P 32

31. Protocetraric acid present, thallus small, 3-4 cm in diam., apothecia common *H. adducta* (Nyl.) Hale

31a. Protocetraric acid absent, conechinocarpic acid and echinocarpic acid present thallus large, up to 20 cm in diam., apothecia absent *H. scytodes* (Kurok.) Hale

32. Medulla C+ rose-red 33

32a. Medulla C- 35

33. Olivetoric acid present *H. intercalanda* (Vain.) Hale
33a. Gyrophoric acid present 34
34. Apothecia 5-20 mm in diameter *H. scytophylla* (Kurok.) Hale
34a. Apothecia 2-4 mm in diameter *H. pluriformis* (Nyl.) Hale
35. Medulla KC-, protolichesterinic acid present *H. flexilis* (Kurok.) Hale
35a. Medulla KC+ orange, protolichesterinic acid absent 36
36. Lobes 1-2 mm wide, physodic acid present *H. livida* (Tayl.) Hale
36a. Lobes 2-8 mm wide, physodic acid absent 37
37. Barbatic acid present, lobes 2-8 mm wide, apothecia up to 10 mm in diameter *H. physcioides* (Nyl.) Hale
37a. Alectoronic acid present, lobes 2-4 mm wide, apothecia upto 3 mm in diameter *H. degelii* (Hale) Hale

1. *Hypotrachyna boquetensis* (Hale) Hale, Smiths. Contr. Bot. **25:** 25 (1975) Fig. 1
Parmelia boquetensis Hale, Phytologia **28:** 265 (1974).
Type: PANAMA. Chiriquí, Boquete, *Hale* 38878; holotype: US - not seen.
Hypotrachyna coorgiana Patwardhan & A.V. Prabhu, Bryologist **80:** 348. 1977.
Type: INDIA. Karnataka, Coorg, *Nagarkar & Patwardhan* 74.3345; holotype: AMH!.

Thallus closely adnate on twigs, up to 10 cm long, irregularly lobed. Lobes sinuate, 3.0-5.0 mm wide, 150-170 µm thick; margins crenate-dentate, eciliate; apices subrotund. Upper surface mineral gray to gray, smooth in peripheral region, rugose and cracked inwards, isidia and soredia absent. Medulla white, 100-125 µm thick. Lower surface black, with 2.0-3.0 mm wide, brown, erhizinate marginal zone, moderately rhizinate. Rhizines black, dichotomously branched, short, upto 0.5 mm long.

Apothecia numerous, substipitate, 3.0-7.0 mm in diameter; disc plane to concave due to incurved margin, imperforate, red brown; amphithecium smooth, rugose with age; epithecium brown, 10-15 µm thick; hymenium 35-55 µm high. Asci clavate, 8 spored, 30-40 x 12-15 µm in size. Spores colourless, simple, oval-ellipsoid, 6-15 x 4-6 µm.

Pycnidia present towards the apical region of the lobes, laminal, immersed. Conidia bifusiform, 7 x 1 µm.

Chemistry: Cortex K+ yellow; medulla K+ yellow turning red, C-, KC-, P+ orange. TLC: Atranorin and salazinic acid; pigmentosin B and a quinine of unknown structure (J. Elix in Pooprang et al. 1999).

Remarks: *H. boquetensis* is characterized by closely adnate thallus on twigs, subrotund lobes, large, numerous apothecia, absence of isidia and soredia and presence of salazinic acid in medulla. In external morphology, nature of apothecia and colour reaction the taxon closely resembles *H. sublaevigata* (Nyl.) Hale, which differs in having pruinose apices and norstictic acid in medulla.

Based on a single specimen, Awasthi (1976) reported the occurrence of *Parmelia sublaevigata* (Nyl.) Nyl., from India. As his specimen contains atranorin and salazinic acid, the chemistry is similar to *Hypotrachyna boquetensis.* The species *Parmelia sublaevigata* vidi Awasthi is now annotated as *Hypotrachyna boquetensis.*

Patwardhan & Prabhu (1977) described *Hypotrachyna coorgiana* Patw. & A.V. Prabhu as a new species from India, based on its distinct geographical distribution from the closely related *H. boquetensis* (Hale) Hale of Panama. The type description tallies well in morphology, anatomy and chemistry with *H. boquetensis* (Hale) Hale. Therefore *H. coorgiana* has been reduced as to synonymy of *H. boquetensis.*

Habitat and altitude: This species is known only to be corticolous (ramicolous) occurring on branches of trees at elevations between 2200-2550 m.

Distribution: Earlier *H. boquetensis* was reported from Panama, Cost Rica (Hale 1975). The taxon is also reported from Thailand as *H. coorgiana* Patw. & A.V. Prabhu (Pooprang et al., Wolseley et al. 2002). It is a new record for Indian lichen flora.

Specimen examined: Karnataka: See type of *Hypotrachyna coorgiana*; Tamil Nadu: Nilgiri Hills, upper Bhavani Road from Avalanche on way to Deverbetta, alt. 2200-2550 m, on twigs, K.P. Singh 71.695 (LWG-LWU).

2. *Hypotrachyna intercalanda* (Vain.) Hale, Smiths. Contr. Bot. **25:** 42 (1975) Fig. 2
Parmelia intercalanda Vain., Acta Soc. Fauna Flora Fenn. 7(1): 53 (1890).
Type: BRAZIL. Minas Gerais, Sitio, *Vainio* Lich. Bras. Exs. 899; lectotype, Hale 1975: TUR-V 3014; isolectotypes: BM, M, UPS - not seen.

Thallus closely adnate to the substratum, 3.0-4.0 cm across, subdichotomously lobate. Lobes sublinear, separate, 1.0-2.0 mm wide, 100-125 µm thick. Upper surface tannish mineral gray, plane to rugulose, faintly maculate, isidia and soredia lacking. Medulla white, 50-60 µm thick. Lower surface black, moderately rhizinate. Rhizines densely dichotomously branched, 1.0-1.5 mm long.

Apothecia common, adnate to substipitate, 2.0-4.0 mm in diameter; disc dark brown; amphithecium rugose, margin crenate, epithecium brown, 10-14 µm thick; hymenium 30-40 µm high. Asci clavate 25-30 x 20-22 µm, 8 spored. Spores colourless, oval-ellipsoid, 10-13 x 6-7 µm.

Pycnidia not seen in the specimens examined.

Chemistry: Cortex K+ yellow; medulla K-, C+ red, KC+ red, P-. TLC: Atranorin, olivetoric acid and unidentified greenish spot at Rf class 5, Rf value 0.40 (in solvent system A).

Remarks: *H. intercalanda* is characterized by sublinear, separate lobed thallus with dense apothecia and presence of a rare olivetoric acid in the medulla. In external morphology it resembles *H. physcioides* (Nyl.) Hale, which differs in having barbatic acid in medulla.

Habitat and altitude: The species is known only to be corticolous at elevation of ca. 2200 m.

Distribution: Earlier Hale (1975) reported the occurrence of this species in Southeastern Brazil and Argentina. This is the new record for Indian lichen flora.

Specimen examined: Tamil Nadu: Palni Hills, Kodaikanal, Pillar Rocks area, alt. 2200 m, on trees, D.D. Awasthi & K. P. Singh 70.292, 70.271 (LWG-LWU).

3. ***Hypotrachyna kingii*** (Hale) Hale, Phytologia **28:** 341 (1974) Fig.3
Parmelia kingii Hale, J. Jap. Bot. **43:** 324 (1968).
Type: THAILAND. Prov. Nakhon Nayok, 14 km south of Khao Yai forest station, *King* L-255; holotype: US; isotype: TNS - not seen.

Thallus adnate to the substratum, upto 6.0 cm across. Lobes sublinear to subirregular, subimbricate, 2.0-5.0 mm wide, 75-100 µm thick; apices rotund; margin ciliate, cilia in lobe axils, simple to furcate. Upper surface mineral gray, without isidia and soredia, pustulate. Pustules breaking open apically but not forming soredia, cortex fragile. Medulla white, 50-60 µm thick. Lower surface black, with a narrow upto 2.0 mm wide, brown, erhizinate marginal zone, rhizinate. Rhizines black, densely dichotomously branched, upto 1.0 mm long.

Apothecia rare, adnate, upto 4.0 mm in diameter; disc dark brown, imperforate; amphithecium smooth with fragile pustules; epithecium brown, 8-12 µm thick; hymenium 30-40 µm high. Asci clavate, 8 spored, 30-40 x 13-17 µm in size. Spore colourless, simple, oval-ellipsoid, (8) 9-11 (12) x (5) 6-7 µm.

Pycnidia not seen in the specimens examined.

Chemistry: Cortex K+ yellow; medulla K+ red, C-, KC-, P+ orange-red. TLC: Atranorin, norstictic acids (major) and salazinic acid (in trace).

Remarks: *H. kingii* is distinguished by pustulate upper surface, fragile cortex and presence of norstictic acid in the medulla. It shows close similarity to *H. dodapetta* Hale & Patw., which has broad lobes (upto 10 mm) and has only salazinic acid in medulla. It also resembles *H. thryptica* (Hale) Hale, which has atranorin, stictic and constictic acid. In chemistry it resembles that of *H. mason-halei* Patw. & A.V. Prabhu, which differs in the absence of pustules.

Habitat and altitude: The species is found on trees of *Eucalyptus* (base of tree) and tea bushes at elevation between 1500-2550 m.

Distribution: Earlier the taxon was known from Thailand, Indonesia and Taiwan (Hale 1968, Kurokawa & Lai 2001) but the present study extends its distribution to South India. It is a new record of Indian lichen flora.

Specimens examined: Kerala: Idukki Dist., Munnar, Rajamally area, along border of tea plantation, alt. 1500-1600 m, on trees, D.D. Awasthi, R. Mathur & R. Tewari 85.125 (LWG-LWU); Tamil Nadu: Doddabetta, Udhagamandalam, alt. 2550 m, on trees, A. Singh L-81248 (LWG); Nilgiri Hills, Kotagiri Road, near Doddabetta tea estate, alt. 2100 m, on tea plant, K.P. Singh 71.1043 (LWG-LWU); Ootacamand, below Doddabetta peak, in *Eucalyptus* plantation, alt. 2200-2400 m, on *Euclayptus* tree, base, D.D. Awasthi & K.P. Singh 71.109 (LWG-LWU); Palni Hills, Kodaikanal, Pillar rock area, alt. 2200-2300 m, on tree, K. P. Singh 70.697 (LWG-LWU).

4. ***Hypotrachyna livida*** (Tayl.) Hale, Smiths. Contr. Bot. **25:** 45 (1975) Fig. 4
Parmelia livida Taylor, Hooker J. Bot. **6:** 171 (1847).
Type: U.S.A. Louisiana. New Orleans, *Hooker* Herbarium; lectotype: FH-TAYL; isolectotype: BM, H-NYL 35109 - not seen.

Thallus closely adante to the substratum, coriaceous, ca 4.0 cm across, dichotomously lobate. Lobes sublinear, sinuate, 1.0-2.0 mm wide, 125-200 µm thick. Upper surface whitish mineral gray, shiny, plane at tips, rugulose in centre, lacking isidia and soredia. Medulla white, 75-115 µm thick. Lower surface black, rhizinate. Rhizines sparsely dichotomously branched, short, upto 1.0 mm long.

Apothecia and pycnidia not seen in the specimens examined.

Chemistry: Cortex K+ yellow; medulla K-, C-, KC+ rose, P-. TLC: Atranorin, physodic and lividic acid.

Remarks: *H. livida* is characterized by the adnate, esorediate and non-isidiate thallus, with physodic and lividic acid in medulla. In chemistry it is similar to *H. immaculata* (Kurok.) Hale, which has a sorediate thallus.

Habitat and altitude: This species is known only to be corticolous and occurs on bark of trees at elevation between 2100-2200 m.

Distribution: *H. livida* was earlier reported from the southeastern USA, the Bahamas, Venezuela, Uruguay, Argentina and SE Brazil by Hale (1975), and from Mato Grosso, SW Brazil by Fleig & Riquelme (1991). This is the first report of this species from India.

Specimen examined: Tamil Nadu: Palni Hills, Kodaikanal, Pillar rocks area, alt. ca 2100-2200 m, on trees, K.P. Singh 70.647 (LWG-LWU).

5. ***Hypotrachyna sinuosa*** (Sm.) Hale, Smiths. Contr. Bot. **25:** 63 (1975) Fig. 5
Lichen sinuosus Sm., Engl. Bot. **29:** 2050 (1809).
Type: ENGLAND. Dumfriesshire, *Burgess*; lectotype: LINN - not seen.
Parmelia sinuosa (Sm.) Ach., Syn. Meth. Lich.: 207 (1814).

Thallus loosely adnate, sometimes ascending at the periphery, 2.0-4.0 cm across, subdichotomously sinuate lobate. Lobes sublinear, short, 1.0-3.0 mm wide, 100-140 µm thick; margin eciliate. Upper surface pale greenish yellow, shining towards periphery, plane, emaculate, sorediate. Soralia subterminal, capitate, 1.0-1.5 mm in diameter, orbicular to diffuse, sometimes heavily sorediate margin become revolute. Medulla white, 70-80 µm thick. Lower surface black, rhizinate, sometimes the rhizines sparse to absent towards centre and forming mat towards periphery, 0.5-1.5 mm long.

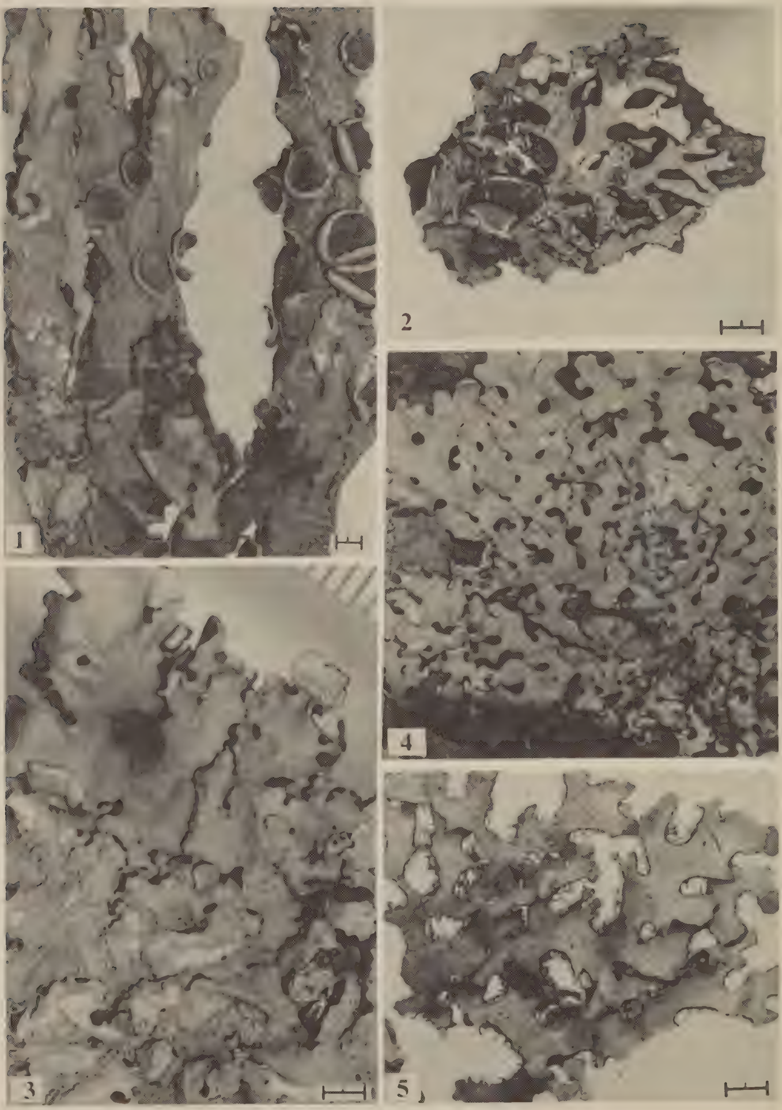
Apothecia and pycnidia not seen in the specimens examined.

Chemistry: Cortex K-; medulla K+ yellow turning red, C-, KC-, P+ orange red. TLC: Usnic, salazinic, norstictic and stictic acid (in trace).

Remarks: The species is distinguished by greenish yellow thallus, sinuate lobes, subterminal, capitate soralia and presence of usnic and salazinic acid. It resembles *H. pseudosinuosa* (Asah.) Hale, especially in size, position of soralia and P+ orange-red medulla, but *H. pseudosinuosa* has atranorin and protocetraric acid.

Habitat and altitude: This species is known to be corticolous and occurs on bark and twigs of the trees at higher elevation between 2900-3700 m.

Distribution: The taxon was earlier known from Nepal, Alaska to Oregon, southeastern United States, Mexico, West Indies, Andean region from Venezuela to Chile, Europe, southeastern Asia from Japan to Papua New Guinea, Australasia and Taiwan (Elix 1994, Hale 1975, Kurokawa & Lai 2001); Tibet (Wei 1991). It is a new record for Indian lichen flora.



Figures 1-5. 1. *Hypotrachyna boquetensis* 71.695 (LWG-LWU), 2. *Hypotrachyna intercalanda* 70.292 (LWG-LWU), 3. *Hypotrachyna kingii* L-81248 (LWG), 4. *Hypotrachyna livida* 70.647 (LWG-LWU), 5. *Hypotrachyna sinuosa* 838 (BSHC) [scale = 2 mm].

Specimen examined: Sikkim: Pangrtakha scrub, alt. 2900 m, on twigs, G.P. Sinha 918 (BSHC); Thangsing, Samiti trek, alt. 3700 m, on trees, G.P. Sinha 838 (BHSC).

HYPOTRACHYNA SPECIES KNOWN FROM INDIA

1. *H. adducta* (Nyl.) Hale
2. *H. adjuncta* (Hale) Hale
3. *H. awasthii* Hale & Patw.
4. *H. boquetensis* (Hale) Hale
5. *H. brevirhiza* (Kurok.) Hale
6. *H. costaricensis* (Nyl.) Hale
7. *H. crenata* (Kurok.) Hale
8. *H. dactylifera* (Vain.) Hale
9. *H. degelii* (Hale) Hale
10. *H. dodapetta* Hale & Patw.
11. *H. endochlora* (Leight.) Hale
12. *H. flexilis* (Kurok.) Hale
13. *H. imbricatula* (Zahlbr.) Hale
14. *H. immaculata* (Kurok.) Hale
15. *H. incognita* (Kurok.) Hale
16. *H. infirma* (Kurok.) Hale
17. *H. intercalanda* (Vain.) Hale
18. *H. kingii* (Hale) Hale
19. *H. koyaensis* (Asahina) Hale
20. *H. livida* (Taylor) Hale
21. *H. mason-halei* Patw. & A.V. Prabhu
22. *H. microblasta* (Vain.) Hale
23. *H. neodissecta* (Hale) Hale
24. *H. neosingularis* Divakar, Upreti & Elix
25. *H. orientalis* (Hale) Hale
26. *H. osseoalba* (Vain.) Y.S. Park & Hale
27. *H. physcioides* (Nyl.) Hale
28. *H. pluriformis* (Nyl.) Hale
29. *H. radiculata* (Kurok.) Elix
30. *H. revoluta* (Flörke) Hale
31. *H. rhabdiformis* (Kurok.) Hale
32. *H. rigidula* (Kurok.) Hale
33. *H. rockii* (Zahlbr.) Hale
34. *H. scytodes* (Kurok.) Hale
35. *H. scytophylla* (Kurok.) Hale
36. *H. sinuosa* (Sm.) Hale
37. *H. thryptica* (Hale) Hale

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CHARACTERIZATION OF USTILAGO TRITICI AND U. NUDA ON WHEAT AND BARLEY. I. TELIOSPORE MORPHOLOGY

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ABSTRACT

Morphology of teliospores of *Ustilago tritici* and *U. nuda* pathogenic on wheat and barley were studied by using light and electron microscopy. The data on teliospore length and width subjected to ANOVA showed significant differences at 1% level between the two species, whereas UPGMA Cluster analysis was not able to separate the two species. The ultrastructure of the two species was found to be substantially similar. In SEM, teliospores of *U. tritici* showed echinulation with more prominent spines than those of *U. nuda.* It is concluded that based only on teliosore morphology, it is difficult to separate the two species, thus making it imperative to use approaches involving DNA polymorphism for species separation.

KEY WORDS: Loose smut, Teliospore ornamentation, Light and Electron Microscopy, Cluster analysis

INTRODUCTION

Loose smut of wheat, *Ustilago tritici* (Pers.: Pers.) Rostr., and that of barley, *U. nuda* (Jensen) Kellerm. & Swingle, occur worldwide and cause damage by destroying the kernels of the infected plants and by smearing and thus reducing the quality of the grain of the healthy plants on harvest. Losses from loose smut may range from 10 to 40 percent in certain localities in a given year (Agrios, 1997).

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The delimitation of the species in smut fungi is mostly based on morphological characters of the teliospores such as spore measurements and spore surface ornamentation (Vánky, 1991).

The unification of the names of *U. tritici* and *U. nuda* has been suggested by Cunningham (1924), Fischer (1943) and by Ainsworth and Sampson (1950) based on growth and spore morphology. However, a strong view also exists for separating *U. tritici* and *U. nuda* at species level by Nielsen (1972,1985) and Langdon and Fullerton (1975). Similarly Alexopoulos *et al.* (1996) and Agrios (1997) also retained separate names for loose smut of wheat and barley as *U. tritici* and *U. nuda* respectively.

In the present investigation attempts have been made to use light and electron microscopical studies to see the differences in the teliospore morphology of these two species parasitising wheat and barley.

MATERIALS AND METHODS

Collection of isolates

Twenty samples of *U. tritici* on wheat and five of *U. nuda* on barley were collected from various parts of Northern India viz., Punjab, Haryana, Himachal Pradesh, Uttar Pradesh, Delhi and it's surrounding places during February and May 1999 (Table 1). The teliospores of these samples were taken from infected heads and subjected to microscopic examination.

Microscopical Studies

I) Light microscopy: One hundred dried teliospores of each sample were dehydrated in Shear's mounting fluid (Chupp, 1940) and observed at 2000X magnification with an Olympus BX50 microscope. Measurements for length and width of the teliospores were taken with the help of an ocular micrometer.

II) Scanning Electron Microscopy: Air dried teliospores were dusted on small pieces of double sided adhesive tape, mounted on specimen stub, and sputter-coated with gold-palladium under vacuum, ca. 20 nm for 4.5 min, 7.5 mA. The specimens were then observed and photographed in a LEO 435 VP SEM, operated at 15kv following the procedure of Vánky (1997).

III) Transmission Electron Microscopy: The fixing of the teliospores for TEM was done as given by Vánky (1997). Teliospores were fixed with 2% glutaraldehyde in 0.1 M Na-Cacodylate buffer at pH 7.2 for one week. After six continuous transfers in 0.1 M Na-Cacodylate buffer, the teliospores were postfixed in 1% Osmium tetraoxide in the same buffer for 1 hr. in the dark, then washed in distilled water, and stained in 1% aqueous Uranyl acetate for 1 hr. in the dark. After five washings in distilled water, the material was dehydrated in an acetone series embedded in Spurr's plastic and sectioned with a rotary hand-operated microtome. Semi thin sections were stained with freshly prepared fuchsin dye and crystal violet, mounted in Entellan and studied under a light microscope. Ultra thin sections were taken by ultramicrotome with glass knives and were mounted on copper slot grids, post-stained with lead citrate for 5 min and examined under a CM10 PHILIPS electron microscope at 60 kv.

Data analysis

The data obtained was analysed by two methods, viz.,

I) Analysis of Variance: The Analysis of Variance (ANOVA) for length and width of *U. tritici* and *U. nuda* teliospores was performed by using GLM procedure of PC SAS (SAS Institute, 1989). The mean comparison of the length and width of the isolates of *U. tritici* and *U. nuda* was separately done using Duncan's Multiple Range Test (DMRT).

II) Hierarchical Cluster Analysis

The dissimilarity matrix was calculated from standardized morphological characters data using Euclidean measure of distance. Unweighted pair group method using arithmetic average (UPGMA) was selected to generate grouping (Sneath & Sokal, 1973).

Table 1: Isolates of *Ustilago tritici* and *U. nuda* collected from Northern India.

Isolate No.	Location	Date of Collection	Isolate No.	Location	Date of Collection
Ut1*	Gurgaon, Haryana	Mar. 99	Ut14	Pusa, Bihar	Mar. 99
Ut2	Bathinda, Haryana	Mar. 99	Ut15	Pusa, Bihar	Mar. 99
Ut3	HAU, Hissar, Haryana	Mar. 99	Ut16	RAU, Bihar	Mar. 99
Ut4	Thaska, Hissar, Haryana	Mar. 99	Ut17	Patna, Bihar	Mar. 99
Ut5	Kaimri, Hissar, Haryana	Mar. 99	Ut18	PAU, Ludhiana, Punjab	Mar. 99
Ut6	Karnal, Haryana	Mar. 99	Ut19	PAU, Ludhiana, Punjab	Mar. 99
Ut7	HPKV, Palampur, U.P.	May 99	Ut20	IARI, New Delhi	Feb. 99
Ut8	Palampur, H.P.	May 99	**Un1****	Havalbagh, Almora,U.P.	Apr. 99
Ut9	Shimla, H.P.	Mar. 99	Un2	Almora, U.P.	Apr. 99
Ut10	IARI, Reg.St.Shimla, H.P.	May 99	Un3	HPKV, Palampur, U.P.	May 99
Ut11	Kumargaj, Faizabad, U.P.	Mar. 99	Un4	Palampur, H.P.	May 99
Ut12	Kanpur, U.P.	Mar. 99	Un5	IARI, New Delhi	Mar. 99
Ut13	Varanasi, U.P.	Mar. 99			

**** Ustilago tritici ** Ustilago nuda***

RESULTS

The length of the teliospores of *U. tritici* varied from 5 μm to 12 μm and width 4 μm to 9 μm. For *U. nuda* the length varied from 5.50 μm to 10 μm and width 5 μm to 8 μm. In case of *U. tritici* the average mean length and width of teliospores was 6.50 μm and 5.71 μm respectively and for *U. nuda* 6.66 μm and 5.82 μm respectively. *U. tritici* isolate Ut6, collected from Karnal, Haryana has the smallest teliospores having mean length

(5.54 µm) and width 5.13µm. In *U. nuda* all the isolates were the same with respect to the length of teliospore. The biggest teliospore size in *U. nuda* with mean of 6.93 µm was in case of Un1, whereas as the maximum mean length of 8.41 µm was observed in *U. tritici* (Ut12) (Table 2).

Table 2: Comparison of the mean length and width of different isolates of *Ustilago tritici* and *U. nuda* using Duncan's Multiple Range Test (DMRT).

Isolate No.	Length (µm)		Width (µm)	
	Mean	Rank	Mean	Rank
Ut1	5.940	I	5.270	JK
Ut2	6.050	HI	5.275	JK
Ut3	6.350	FG	5.670	EFGH
Ut4	6.690	CD	5.800	DE
Ut5	6.365	FG	5.775	DEF
Ut6	5.540	J	5.135	K
Ut7	6.470	DEF	5.940	D
Ut8	5.935	I	5.350	IJ
Ut9	6.710	C	6.170	C
Ut10	7.140	B	6.480	B
Ut11	6.420	EFG	5.575	GH
Ut12	8.410	A	7.215	A
Ut13	6.710	C	5.720	EFG
Ut14	6.730	C	5.700	EFG
Ut15	6.620	CDE	5.490	HI
Ut16	6.656	CDEF	5.635	EFGH
Ut17	6.200	GH	5.330	IJ
Ut18	6.375	FG	5.590	FGH
Ut19	6.435	EF	5.615	EFGH
Ut20	6.530	CDEF	5,590	FGH
Un1	6.930	A	6.205	A
Un2	6.655	B	6.030	A
Un3	6.600	B	5.520	B
Un4	6.650	B	5.630	BC
Un5	6.585	B	5.735	C

ANOVA showed significant differences at 1% level between the two species and among isolates within species for both length and width of *U. tritici* and *U. nuda* teliospores (Table 3).

Table 3: ANOVA of isolates of *Ustilago tritici* and *U. nuda* for length and width of the teliospores.

Source of Variance (S.V.)	Degree of Freedom (Df)	Mean Square (MS) *	
		Length	Width
Species	1	9.579	4.752
Isolates / species	23	27.281	19.891
Iso. (*U.tritici*)	19	32.461	22.365
Iso. (*U.nuda*)	4	2.679	8.139
Error	2475	0.5317	0.3505
Coefficient of Variation (%)		11.15	10.32

***: All sources of variance are significant at 1% level.**

Based on DMRT data, results showed that there were 10 classes in case of *U. tritici* and 2 in *U. nuda* with respect to length and 11 in *U. tritici* and 3 in *U. nuda* with respect to width of teliospores. Ut12 is separated from all other isolates by DMRT. The length and width data of the teliospores of various isolate of *U. tritici* and *U. nuda* was subjected to cluster analysis-using UPGMA on distance matrix based on Euclidean measure. The cluster analysis also separates isolate Ut12 from all other isolates (Figure 1). The remaining isolates were subdivided into 2 groups, one comprising of Ut1, Ut8, Ut2, Ut17 and Ut6 and the other comprising of the rest. This second big cluster comprised of two groups of which one was a large group having 15 isolates including Ut13, Ut14, Ut4, Ut16, Un4, Ut15, Un3, Ut20, Ut11, Ut18, Ut19, Ut3, Ut5, Un5, Ut7 and other comprising of only 4 isolates including Ut9, Un2, Un1, Ut10. According to DMRT, Un1 and Un2 were grouped together whereas Un3, Un4 and Un5 belonged to a different rank. The cluster analysis based on teliospore length and width however could not separate *U. tritici* and *U. nuda*.

Teliospores of *U. tritici* are dark brown, lighter colored on one side, globose to subglobose, to ovoid. Under SEM they are minutely echinulate. Echinulation was observed to be greater on the lighter side of the teliospores. The size varied from 5-12 µm (6.50 ± 0.91) X 4-9 µm (5.71 ± 0.73). Teliospores of *U. nuda* are olivaceous brown, lighter colored on one side, globose to subglobose, sometimes elongate and the light colored side of the teliospore is thin and flattened while the slightly convex side is thickened. SEM showed that teliospores in *U. nuda* are minutely echinulate

Figure 1: Dendrogram of *Ustilago tritici* and *U. nuda* resulting from UPGMA based on length and width of teliospores.

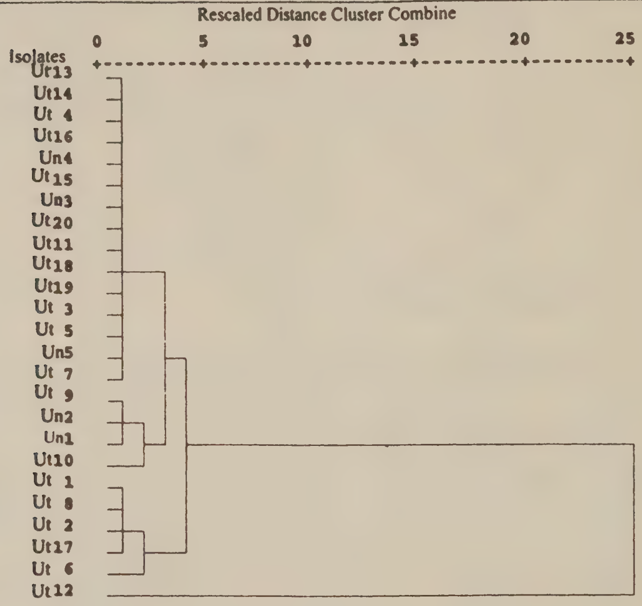
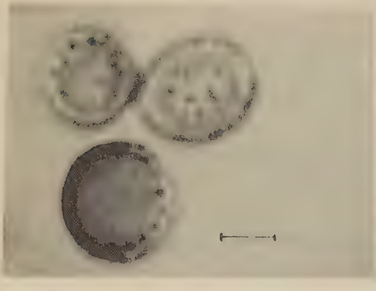


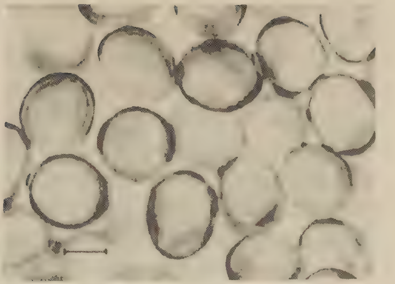
Plate 1: Figs 1 and 2. Teliospores of *Ustilago tritici* (Ut12) and *U. nuda* (Un1) seen by LM. Bar =5 µm.

Figs 3 and 4. SEM of surface ornamentation of teliospores of *U. tritici* (Ut12) and *U. nuda* (Un1). Bar =2 µm.

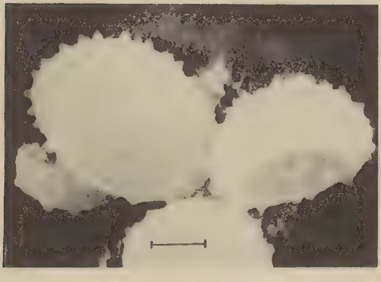
Figs 5 and 6. Ultra thin sections of teliospores of *U. tritici* (Ut12) and *U. nuda* (Un1) in TEM, showing two wall layers, outer layer (OL) and inner layer (IL) and spines (Sp). Bar =1 µm.



1

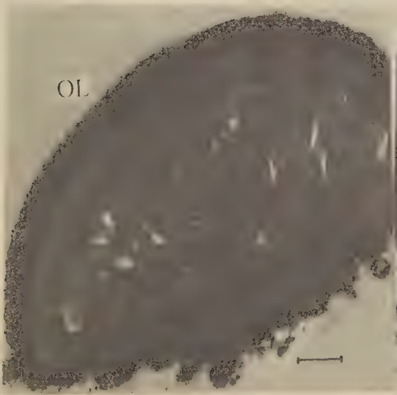


2



3

4



5

6

with sparse spines but in *U. tritici* the spines are more prominent than in *U. nuda*. Here the size varied from 5.50-10 μm (6.66 ± 0.75) X 5-8 μm (5.82 ± 0.68). In both the species the cell wall has two distinct layers. The outer layer is electron dense and dark and the inner layer exhibit uniform electron density, which has corky texture with some sort of cellular organization. The spines, which are highly electron dense, are appended on the surface of the outer layer. In *U. tritici* both cell wall layers appear uniformly thickened but in *U. nuda* inner layer is thicker under the thinner part of the outer layer. Width of the outer layer is similar in both species and the protoplasmic membrane is distinct from the cytoplasm, which is granular in nature (Plate 1). From the results obtained it is concluded the ultrastructure of the two species were found to be substantially similar.

DISCUSSION

There are a number of similarities in morphology and biology of *Ustilago* spp. on wheat and barley, which has led from time to time to propound various proposals that the two smuts are synonymous or only specialized varieties or forms of the same species. Criteria accepted by some mycologists are rejected by others. A review of the literature showed that the single-species concept is very far from being universally accepted by mycologists and plant pathologists. Some are probably reluctant to give up the long-standing use of separate names for each smut, whereas others find the arguments for the single-species concept unconvincing. These arguments are mainly due to the fact that in the loose smut of wheat and barley the infection type, spore morphology and morphological characteristics after germination of the spores are identical.

Cunningham (1924) suggested unification under the name *U. tritici*, because the two forms differ only in that each is confined to its host, but as they are identical in morphological characters, they must be considered as the same species. Fischer (1943) united the two species under the name *U. tritici*, with "*Specialized varieties*" on wheat and barley. However, Fischer & Hirschhorn (1945), Ainsworth and Sampson (1950) and Fischer (1953) adopted and used the name *U. nuda* with "Specialized races" on wheat and barley. Lindeberg and Nannfeldt (1959) united them under *U. tritici*.

Popp (1955) considered that a) *U. tritici* produces growth only from individual cells of the promycelium, whereas *U. nuda*, develops it only from conjugate cells, and b) the promycelial branches of *U. tritici* are monokaryotic, whereas those of *U. nuda* are predominantly dikaryotic. He concluded that *U. tritici* and *U. nuda* are separable at the species level. Nielsen (1972) concluded that both mating types of *U. tritici* grow readily on a minimal medium, in contrast to *U. nuda*, whose mating type a is proline-deficient. This fundamental physiological difference, supported by previously known morphological differences, is used as evidence to retain *U. tritici* and *U. nuda* as separate species and to reject claims that they should be included under one name. Similarly Langdon & Fullerton, (1975) observations have shown that *U. tritici* destroys the epidermis of the host but *U. nuda* does not. Khanna *et al.* (1971) studied the ultrastructure of *U. tritici* and *U. nuda* and found that the ultrastructures of both species are substantially similar.

Nielsen (1985) rejected the use of trinomial system for *U. tritici* because of the multitude of possible *formae speciales* and the overlapping of pathogenicity by races on several host species, although Hawksworth *et al.* (1995) in the 8th edition of the Dictionary of the Fungi considered loose smut of wheat and barley as *U. segetum* var. *tritici*, which was accepted by Mordue and Ainsworth (1984), but cautioned that the causal organisms of loose smuts of cereals are biologically distinct but morphologically close and variously treated as species, varieties or even physiologic races.

Studies undertaken by us on teliospore morphology could not differentiate *U. tritici* from *U. nuda* based on teliospore length and width but minute differences were observed under SEM with reference to the echinulation on the teliospore wall. This has led us to investigate the use of molecular fingerprinting techniques in order to detect variability amongst *U. tritici* and *U. nuda* as well as to justify their separation at species level.

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CHARACTERIZATION OF USTILAGO TRITICI AND U. NUDA ON WHEAT AND BARLEY. II. RAPD ANALYSIS

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ABSTRACT

Monokaryotic haploid hyphae of fourteen isolates of *Ustilago* spp. pathogenic on wheat and barley were analyzed by random amplified polymorphic DNA analysis (RAPD) using twenty-five decamer primers. The results of the RAPD analyses showed that a high degree of variability exists among isolates of *Ustilago tritici*. Isolate Ut12 gave a distinct pattern and was separated from all others by UPGMA cluster analysis. Amplification products obtained with primers OPN5 and OPM6 were able to clearly separate *U. nuda* isolates from all the *U. tritici* isolates. The study highlights the fact that DNA polymorphism can be used to separate *U. nuda* from *U. tritici*, which could not be done on the basis of teliospore morphology.

KEY WORDS: Monokaryotic haploid hyphae, Loose smut, DNA analysis, UPGMA cluster analysis

INTRODUCTION

Loose smut fungi infecting wheat and barley are closely related filamentous basidiomycetes that are destructive pathogens. They cause heavy losses when susceptible varieties with infected seeds are grown under monocropping. The causal organisms of these cereals are biologically distinct but morphologically closely related and variously treated as different species, varieties or even physiological races (Hawksworth *et al.*, 1995).

These fungi are identical in morphology of their teliospore, germination type, mode of infection and the fact that certain races can be hybridized on a common host to form F1 teliospores (Nielsen, 1987).

Recent developments in DNA-based technology including random-amplified polymorphic DNAs (RAPD) has provided suitable tools for rapid and detailed genetic analysis of higher organisms (Rafalski *et al.*,1991; Williams *et al.*,1990). The genetic diversity is assessed by amplification at low stringency with a single short primer of arbitrary sequence. The RAPD technique has been used to detect genetic variations among strains or isolates within a species (Cooke *et al.*, 1996; Hseu *et al.*, 1996; Boyd & Carris, 1997; Jeng *et al.*, 1997; Maurer *et al.*, 1997; Pei *et al.*, 1997; Jungehulsing & Tudzynski, 1997).

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The studies undertaken by various workers on teliospore morphology indicate a high degree of relatedness of *U. tritici* and *U. nuda*. In the present investigations no definite criteria could be established to separate the two *Ustilago* species based on teliospore morphology (Sharifnabi *et al.*, 2002). Keeping this in view, the present work was undertaken to characterize *U. tritici* and *U. nuda* based on DNA polymorphism to arrive at a certain conclusion for separation at the species level.

MATERIALS AND METHODS

Collection of isolates

Twenty isolates of *U. tritici* on wheat and five of *U. nuda* on barley were collected from various parts of Northern India viz., Punjab, Haryana, Himachal Pradesh, Uttar Pradesh, Delhi and it's vicinity during February and May, 1999. The teliospores samples were taken from infected heads and subjected to following investigations.

Cultural conditions

Monokaryotic haploid hyphae of these isolates were obtained as per method of Sharifnabi *et al.* (2000). Teliospores were surface sterilized and resuspended in sterile distilled water and 150-250 ml of sterilized teliospore suspension was evenly spread on petri dishes containing 1.5-2 mm thick, 1.5% water agar and DL-aspartic acid (0.147 mg/ml water). The petri dishes were incubated at 20°C for about 30 hours and subsequently 1 square cm blocks of medium from these plates were transferred to plates with a 1.5-2 mm thick layer of 1/5 of normal nutrient concentration of PDA (Potato Dextrose Agar) and incubated in a refrigerator overnight. The squares were then transferred to another 1.5-2 mm thick layer of 1/5 PDA pre-warmed to 25°C and kept there for 4-6 hours. Monokaryotic haploid hyphae were obtained and isolated by microsurgery with very thin pasteur pipettes and transferred to a thick layer of 1/5 PDA and kept at 20°C for two weeks. The mycelial mass production of the mycelium of haploid hyphae obtained by incubation in PSB (Potato Sucrose Broth) in shaker incubator at 130 rpm at 20°C for 14-20 days and subsequently mycelial growth in PSB was harvested by filtration through Whatman filter paper No. 41. These cultures were then rinsed with sterile distilled water and frozen at -20°C. The frozen samples were used for DNA extraction.

DNA Extraction

Because of the slow growth habit of *Ustilago* spp., a modified procedure from the cetyltrimethylammonium bromide (CTAB) method of Shi *et al.* (1996) was followed. The frozen mycelium of each isolate was ground in sterile mortar and pestle using liquid nitrogen. The fine frozen powder was transferred to a sterile centrifuge tube. Pre-warmed at 65°C DNA extraction buffer [100mM Tris-HCl (pH 8.0), 50 mM EDTA(pH 8.0), 1.4M NaCl and 2% CTAB] was added to this and incubated in a water bath at 65°C for 1 hour. After incubation an equal volume of chloroform / isoamyl alcohol (24:1) was added and mixed gently for centrifugation at 10000 rpm, 25°C for 10 min. The aqueous phase was transferred to a new sterile tube and the DNA was precipitated with 0.6 volume of cold isopropanol and 0.1 volume of sodium acetate (3M, pH 5.2) for 25 min at room temperature. DNA was pelleted by centrifugation at 10000 rpm for 10 min at 25°C. The pellet was washed with cold 70% ethanol and resuspended in sterile distilled water.

Purification of DNA

A stock solution of RNase-A was prepared @ 10 mg/ml in 10mM Tris-HCl pH 8.0 and 15mM sodium chloride. The solution was boiled for 10 min to destroy DNase. From the stock, 2μl of RNase-A was added to the crude DNA sample and incubated at 37°C for 1 hour. The DNA concentration of the samples and its purity was determined by taking ultraviolet absorbance at 260 nm and 280 nm in a spectrophotometer.

Random Amplification of Polymorphic DNA (RAPD) conditions

Thirty-four 10-mer oligonucleotides from sets P, S, M and N (Operon Technologies, Inc, USA) were used as single primers for the amplification of sequences. The PCR reaction was performed in a Gene-Cycler (Bio-RAD, USA), in a 25μl volume containing 4μl of 1X reaction buffer (10mM Tris-HCl, pH 8.3 and 50mM KCl), 5mM $MgCl_2$, 0.5 unit of Taq DNA polymerase, 100μM each of dATP, dCTP, dGTP and dTTP (GENEI, Bangalore, India), 1 μM of 10 mer primer and 25 ng of template DNA. The amplification conditions were: initial step of denaturation at 94°C for 2 min followed by 40 cycles of denaturation at 92°C for 1 min, primer annealing at 37°C for 1 min and extension at 72°C for 2 min, followed by an extended elongation step at 72°C for 5 min. Samples of 25μl PCR products were mixed with 3 μl of 10X loading dye (0.25%

bromophenol blue, 0.25% xylene cyanol and 40% sucrose, W/V) and spun briefly in a micofuge before loading (Sambrook *et al.*,1989). The amplification products were analysed on 1.2% agarose gel containing 0.2 μg/ml of ethidium bromide in 1X TAE buffer running at 60 volts for three hours and visualized under UV light and photographed on Polaroid 6 67 film under Ultra-Violet light. The DNA size marker used was λDNA double digested with *Eco*RI and *Hin*dIII.

Scoring and data analysis

Each amplification product was considered as a RAPD marker. Gels were scored on the basis of the presence (1) or absence (0) of each band for all isolates. All amplifications were repeated at least twice and only reproducible bands were considered for analyses. Jaccard's similarity coefficient values for each pairwise comparison between isolates were calculated (Jaccard, 1908) and a similarity coefficient matrix was constructed. This matrix was subjected to unweighted pair-group method for arithmetic average analysis (UPGMA) to generate a dendrogram using average linkage procedure. All the numerical taxonomic analyses were conducted using software NTSYS-pc, version 1.80 (Exeter Software, NY).

RESULTS

The isolates of *U. tritici* and *U. nuda* were subjected to purification by obtaining monokaryotic haploid hyphae. The hyphae were then multiplied on potato sucrose broth to raise mycelial mass for DNA extraction. However, only 12 isolates of *U. tritici* (Ut2, Ut3, Ut4, Ut6, Ut7, Ut8, Ut10, Ut11, Ut12, Ut15, Ut17 and Ut20) and two isolates of *U. nuda* (Un2 and Un4) yielded sufficient mycelium for DNA extraction and were further taken up for RAPD analysis.

Optimization of RAPD markers

Good quality DNA of concentration 1 00 ng/μl was obtained from approximately 200mg of frozen mycelial mass. Standardization of the PCR protocol was done by changing the variables like template DNA, Taq DNA polymerase and magnesium chloride. The optimum amplification was obtained by using the reaction mix having 25ng template DNA, 0.5 unit Taq polymerase, 5mM $MgCl_2$, 1 μM primer and 100 μM dNTP in reaction volume of 25μl.

Thirty four random 10 mer Operon primers from a set of OPP, OPS, OPM and OPN were screened and out of them twenty five were selected for doing RAPD analysis on the basis of reproducible and scoreable polymorphic bands obtained (Table 1).

The numbers of total bands as well as polymorphic bands obtained in case of *U. tritici* were much more than *U. nuda*. In case of *U. tritici* total numbers of bands obtained were 345 out of which 342 were polymorphic whereas in *U. nuda* out of 129 total bands only 98 gave a polymorphic pattern. Maximum numbers (26) of bands were obtained with primer OPS5 in case of *U. tritici* and all of them were polymorphic. In case of *U. nuda*, primer OPP2 and OPS8 gave 10 bands of which 8 were polymorphic for

Table 1: primers used and the number of total and polymorphic bands produced in *Ustilago tritici* and *U. nuda*.

Primer	Sequence (3' - 5')	*U. tritici*		*U. nuda*	
		Total bands	Polymorphic bands	Total bands	Polymorphic bands
OPM06	CTGGGCAACT	15	15	6	0
OPM07	CCGTGACTCA	20	20	6	6
OPM13	GGTGGTCAAG	16	16	5	4
OPN02	ACCAGGGGCA	7	7	2	2
OPN05	ACTGAACGCC	15	15	8	0
OPN17	CATTGGGGAG	12	12	3	1
OPP01	GTAGCACTCC	11	11	3	3
OPP02	TCGGCACGCA	14	13	10	8
OPP03	CTGATAGGCC	12	12	5	4
OPP04	GTGTCTCAGG	13	13	6	6
OPP05	CCCCGGTAAC	6	6	1	1
OPP06	GTGGGCTGAC	12	12	8	6
OPP08	ACATCGCCCA	17	17	4	2
OPP09	GTGGTCCGCA	13	13	3	3
OPP10	TCCCGCCTAC	11	11	4	4
OPP16	CCAAGCTGCC	17	17	5	5
OPP19	GGGAAGGACA	13	12	9	8
OPP20	GACCCTAGTC	12	12	2	1
OPS01	CTACTGCGCT	10	10	3	3
OPS02	CCTCTGACTG	11	11	3	3
OPS03	CAGAGGTCCC	20	19	8	6
OPS05	TTTGGGGCCT	26	26	8	7
OPS06	GATACCTCGG	12	12	2	2
OPS08	TTCAGGGTGG	18	18	10	8
OPS09	TCCTGGTCCC	12	12	5	5
		345	342	129	98

each of them. The size fragments obtained for *U. tritici* and *U. nuda* varied from 0.5 to 4 kb.

UPGMA cluster analysis

The data were obtained from RAPD analysis of 12 isolates of *U. tritici* and 2 isolates of *U. nuda* with 25 primers was subjected to UPGMA analysis. A dendrogram for these 14 isolates was prepared using the similarity coefficient of RAPD marker (Fig. 1). The dendrogram revealed the existence of variability among isolates of *U. tritici*, whereas isolates of *U. nuda* are grouped together in one cluster. Among the *U. tritici* isolates, Ut12 was found to be separated from all other isolates of *U. tritici* and *U. nuda*. The rest of the *U. tritici* isolates were divided into two major clusters with Ut3 and Ut11 belonging to one and Ut2, Ut7, Ut4, Ut6, Ut8, Ut10, Ut15, Ut17 and Ut20 to the other cluster. These clusters were further divided into smaller clusters.

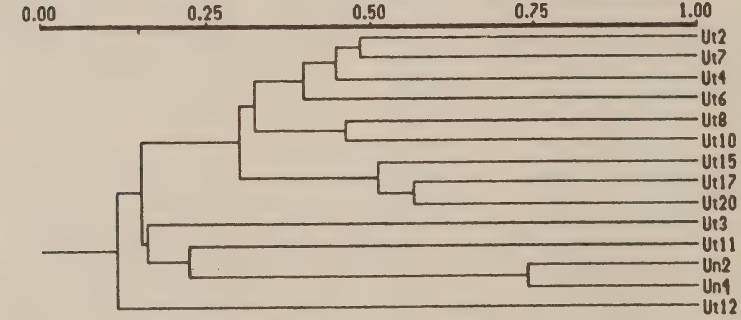

Fig. 1: Dendrogram from RAPD analysis of *Ustilago tritici* (Ut) and *U. nuda* (Un) isolates. Scale is distance by UPGMA method as implemented in NTSYS-pc.

UPGMA cluster analysis was also done for RAPD markers obtained with primer OPN5 and OPM6 for *U. tritici* and *U. nuda*. This was done because the two primers showed a very distinct pattern clearly differentiating *U. nuda* from *U. tritici* (Plate 1). In case of *U. nuda* the banding pattern was monomorphic with both OPN5 and OPM6, whereas in *U. tritici* the primers gave polymorphic pattern. The dendrogram obtained separated *U. nuda* completely from all the isolates of *U. tritici*. The cluster analysis revealed Un2 and Un4 to be exactly similar. In this dendrogram all the isolates of *U. tritici* including Ut12 belong to a separate cluster than *U. nuda*. Ut12 belongs to the same cluster as Ut3 and Ut11, but is separated from them at 20% level. Ut17 and Ut20, which are grouped in the same cluster in Fig. 1, appear as completely identical isolates in Fig. 2, except for

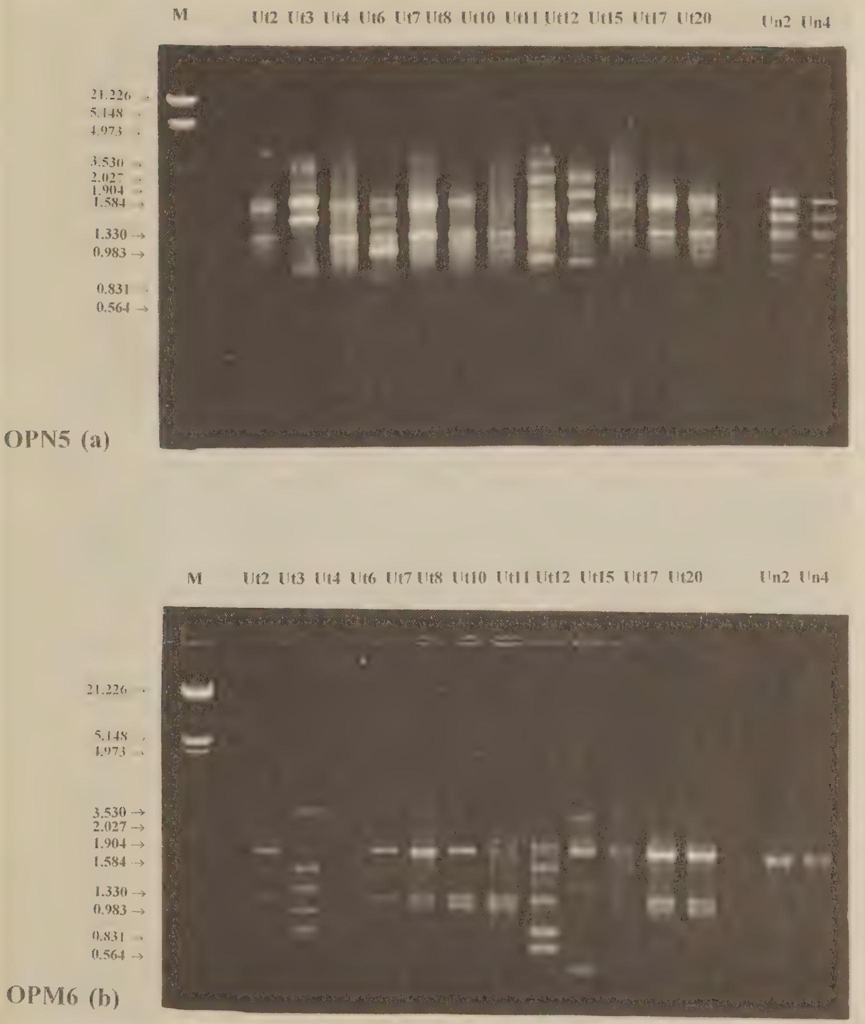
M
Ut2 Ut3 Ut4 Ut6 Ut7 Ut8 Ut10 Ut11 Ut12 Ut15 Ut17 Ut20 Un2 Un4
21.226
5.148
4.973
3.530
2.027
1.904
1.584
1.330
0.983
0.831
0.564
OPN5 (a)
M
Ut2 Ut3 Ut4 Ut6 Ut7 Ut8 Ut10 Ut11 Ut12 Ut15 Ut17 Ut20 Un2 Un4
21.226
5.148
4.973
3.530
2.027
1.904
1.584
1.330
0.983
0.831
0.564
OPM6 (b)

Plate 1: RAPD analysis of 12 isolates of *Ustilago tritici* (Ut) and 2 isolates of *U. nuda* (Un) with primers OPN5 (a) and OPM6 (b). The products were separated in a 1.2% agarose gel and stained with ethidium bromide. Lane M is λDNA double digested with *Eco*RI and *Hin*dIII.

the grouping of Ut8 and Ut15 together in one cluster and Ut10 in another. The dendrogram obtained from *U. tritici* isolates was found to be similar to Fig.1 (Fig. 2).

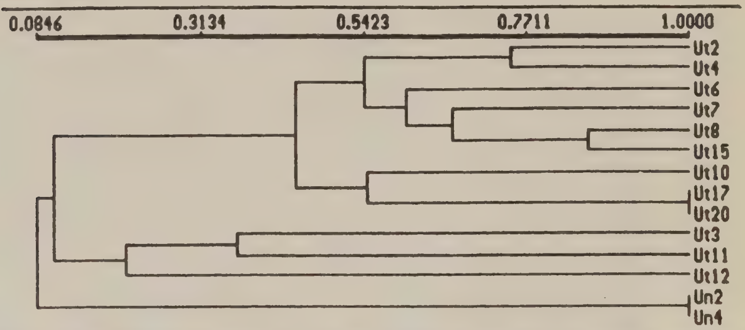

Fig. 2: Dendrogram generated using UPGMA analysis demonstrating the relationships among *Ustilago tritici* and *U. nuda* based on RAPD data from primers OPN5 and OPM6.

Even by using the data from only primer OPN5 we could differentiate *U. nuda* isolates from *U. tritici*. Un2 and Un4 are grouped together but belong to a major cluster comprising of other *U. tritici* isolates. Ut3, Ut11 and Ut12 are separated from other *U. tritici* isolates as well as two isolates of *U. nuda*. Isolates (Ut2 and Ut4), (Ut8 and Ut15), (Ut17 and Ut20) are identical to each other (Fig. 3).

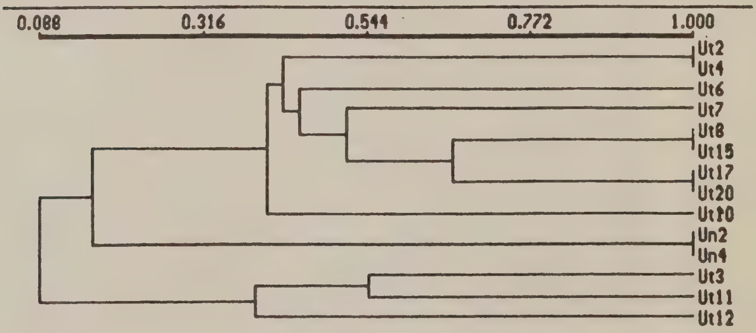

Fig. 3: Dendrogram of RAPD profiles of *Ustilago tritici* and *U. nuda* isolates constructed using NTSYS-pc based on data analysis from primer OPN5.

DISCUSSION

Loose smut of wheat and barley is caused by the heterobasidiomycetous fungi in the genus *Ustilago*. A trinomial system to designate strains that are specialized on certain host species is impractical because of the multitude of possible *formae specialis* and the overlapping pathogenicity of each strain on several host species or genera (Nielsen, 1985). Kim *et al.*(1984) compared the detergent-soluble polypeptides patterns of *U. tritici* and *U. nuda* and found that they differed by 47 polypeptides; this high level of interspecific variation supports the concept of treating these two pathogens as separate taxa.

As *U. tritici* and *U. nuda* have identical teliospores and a similar biology, the two have been claimed to be same organism. This taxonomic treatment, based solely on teliospore morphology is untenable because it ignores the important differences (Kellerman & Swingle, 1889; Kim *et al.*, 1984; Kanehira & Shinohara, 1986; Vanky, 1994). These differences justify *U. tritici* and *U. nuda* as valid, though related species. *U. nuda* may have evolved from *U. tritici* (Nielsen, 1987).

The present investigation involving studies on teliospore morphology was not able to help us in separating *U. tritici* from *U. nuda* (Sharifnabi *et al.*, 2003). This prompted us to undertake research in the area of using DNA polymorphism for separating the two. Similar approaches have been undertaken for *Tilletia* spp. where again lack of sufficient morphological characters has resulted in grouping of species with morphologically similar species. Shi *et al*. (1996) used 23 RAPD markers to divide 96 isolates of *Tilletia* spp. into two groups with 12% similarity. The analysis of 16 isolates belonging to the *Tilletia fusca* complex using RAPD markers, and a subset of eight isolates using RFLP markers, supports the separation of the *Vulpia*-infecting variety *fusca* from *Bromus*-infecting varieties *bromi-tectorum* and *guyotiana* (Boyd & Carris, 1997).

Different isolates of the two species subjected to RAPD analysis using 25 random decamer primers gave interesting information regarding variability among each of them and was also able to separate *U. tritici* from *U. nuda* isolates. *U. nuda* isolates gave identical banding pattern with primer OPN5 and OPM6 and this pattern was very distinct from the banding pattern of *U. tritici* isolates. The *U. tritici* isolates amongst them selves showed a high degree of variability. Ut12 isolate from Kanpur, U.P. which has separated from others by its teliospore size, gave a distinct pattern and was separated from all other isolates by UPGMA cluster analysis. The clustering of isolates based on RAPD analysis does not bear any correlation with the geographical distribution of the isolates nor with the grouping based on teliospore morphology.

Therefore, in the light of these researches, the present work provides us a strategy to separate *U. tritici* from *U. nuda* and highlights the importance of the use of molecular approaches to differentiate species as an additional aid in taxonomic classification where other characters are either lacking or identical to each other. This tool needs to be exploited to it's fullest potential by separating the number of isolates in question as well as availability of the desired facilities.

ACKNOWLEDGEMENTS

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UROCYSTIS SICHUANENSIS SP. NOV. (UROCYSTALES) AND A UROCYSTIS NEW TO CHINA

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Abstract: A new species, *Urocystis sichuanensis*, on *Triticum aestivum* is described from Sichuan Province, China. *Urocystis pseudoanemones* is a new species for China.

Key words: *Urocystis pseudoanemones*, smut fungi

An unknown species of *Urocystis* was discovered on a specimen of *Triticum aestivum* kept in the Mycological Herbarium, Institute of Microbiology, Chinese Academy of Sciences (HMAS). Several sori are formed in the ovaries, glumes, paleas and lemmas (Fig. 1). Its spore balls measure 15.5-50×14-35 μm and are composed of 1-6(-9) ustilospores. Usually infection with *Urocystis* on Graminea is known as striae on leaves, sheaths and stems, or in the inflorescence. Previously only one species of *Urocystis*, *U. tritici,* was known to infect species of *Triticum* attacking the leaves, sheaths and stems. Its spore balls measure 18-41.5×15-34 μm and are composed of 1-3(-5) ustilospores. These two species differ mainly in soral position, the ustilospore number per spore ball and the size of spore balls.

Urocystis sichuanensis L. Guo, **sp. nov.** Figs. 1-2

Sori in ovariis, glumis, paleis, et lemmatibus. Massa sporarum nigrobrunnea, pulverulenta. Glomeruli sporarum subglobosi, ellipsoidei, ovoidei, elongati vel irregulares, 15.5-50×14-35 μm, e ustilosporis 1-6(-9) (numeri ustilosporarum: 1=16%, 2=34%, 3=26%, 4=11.5%, 5=7.5%, 6=3%, 7=0.5%, 8=0.5%, 9=1%) constructi, cellulis sterilibus omnino circumdati. Ustilosporae subglobosae, ovoideae, ellipsoideae, elongatae vel irregulares, 10.5-22.5×10-15.5 μm, flavidobrunneae vel rufobrunneae; pariete 1-1.5 μm crasso. Cellulae steriles ellipsoideae vel subglobosae, 6-12×4-7 μm, flavidobrunneae, levi.

Supported by the National Natural Science Foundation of China.

Sori in ovaries, glumes, paleas and lemmas. Spore mass blackish-brown, powdery. Spore balls subglobose, ellipsoidal, ovoid, elongated or irregular, 15.5-50×14-35 µm, composed of 1-6(-9) ustilospores (1=16%, 2=34%, 3=26%, 4=11.5%, 5=7.5%, 6=3%, 7=0.5%, 8=0.5%, 9=1%), completely surrounded by sterile cells. Ustilospores subglobose, ovoid, ellipsoidal, elongated or irregular, 10.5-22.5×10-15.5 µm, yellowish-brown or reddish-brown; wall 1-1.5 µm thick. Sterile cells ellipsoidal or subglobose, 6-12×4-7 µm, yellowish-brown, smooth.

On *Triticum aestivum* L., Sichuan: Rongbacha, VIII 1952, X. Q. Liu & Z. M. Yang 1810a, HMAS 84433 (holotypus). Known only from the type collection.

Urocystis pseudoanemones Denchev, Kakish. & Y. Harada
Mycoscience 41:453, 2000 Figs. 3-4

Sori in leaves and petioles, causing swellings, at first covered by the epidermis, later ruptured. Spore mass black or blackish-brown, powdery. Spore balls subglobose, ellipsoidal, elongated or irregular, 15-54×14-34 µm, composed of 1-6(-12) ustilospores (1=4.5%, 2=17.1%, 3=23.4%, 4=24.3%, 5=13.5%, 6=6.3%, 7=3.2%, 8=4.5%, 9=0.9%, 10=0.9%, 11=0.9%, 12=0.5%), incompletely surrounded by sterile cells. Ustilospores subglobose, ovoid, ellipsoidal, elongated or irregular, 9.5-17.5×7.5-12.5 µm, reddish-brown or chestnut brown. Sterile cells subglobose or ellipsoidal, 7.5-14×5-8.5 µm, yellowish-brown; wall 1-1.5 µm, smooth.

On *Anemone demissa* Hook. f. & Thoms., Shanxi: Taibaishan, 3 X 1937, T. N. Liou & P. C. Tsoong 1350, HMAS 23673; 27 IX 1938, T. N. Liou & P. C. Tsoong 1235, HMAS 23674.

On *Anemone rivularis* Buch.-Ham. ex DC. var. *flore-minore* Maxim., Shanxi: Wutaishan, 9 IX 1959, J. H. Yu & R. Liu 946, HMAS 31432.

On *Anemone silvestris* L., Beijing: Songshan, 12 VI 1986, L. Guo 720, HMAS 55284.

When Denchev *et al.* (2000) published the new species *Urocystis pseudoanemones*, they gave an indistinct description of the ustilospore number per spore ball. They recorded that " the spore balls of *U. pseudoanemones* are composed of 1-5 ustilospores" and " 1-5(-11) ustilospores" in different paragraphs. Guo (1999) reported *Urocystis antipolitana* Magus on *Anemone* sp. as a new Chinese record. Its spore balls are composed of 1-6(-7) ustilospores almost completely surrounded by sterile cells (Vánky 1994). *Urocystis antipolitana* differs from *U. pseudoanemones* in having fewer ustilospores per spore ball. Wang & Piepenbring (2002) published a new Chinese record, *U. pseudoanemones*, on *Anemone tomentosa* (Maxim.) Pei having

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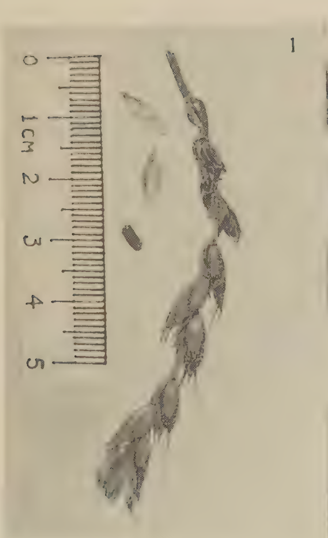
Fig. 1. Sori of *Urocystis sichuanensis* on *Triticum aestivum* (HMAS 84433, holotype).

Fig. 2. Spore balls, ustilospores and sterile cells of *Urocystis sichuanensis* in LM (HMAS 84433, holotype). Bar = 11 µm

Fig. 3. Sorus of *Urocystis pseudoanemones* on *Anemone silvestris* (HMAS 55284).

Fig. 4. Spore balls, ustilospores and sterile cells of *Urocystis pseudoanemones* on *Anemone silvestris* in LM (HMAS 55284). Bar = 11 µm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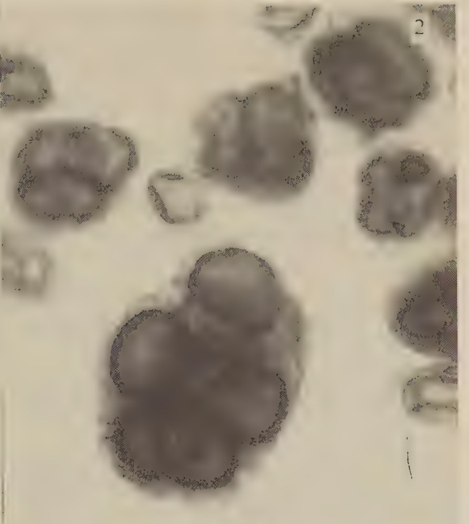
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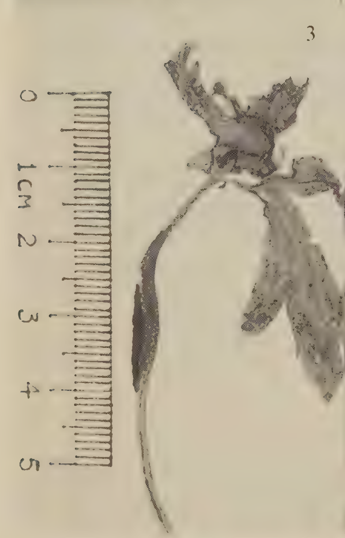
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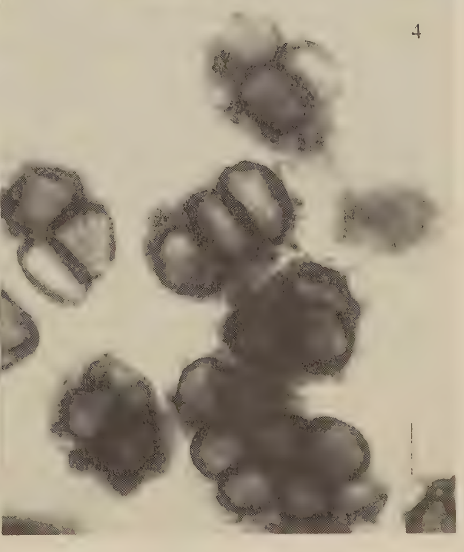
4

1-6(-7) ustilospores per spore ball. This specimen, in my opinion, represents *Urocystis antipolitana*. *Urocystis japonica* (Henn.) Ling is closely related to *U. pseudoanemones*, but it has more ustilospores per spore ball. Moreover, *U. japonica* differs from *U. pseudoanemones* in having spore balls completely surrounded by sterile cells.

U. pseudoanemones is new to China (Ling 1953, Wang 1963, Tai 1979). *Anemone demissa*, *Anemone rivularis* var. *flore-minore* and *Anemone silvestris* are new host plants for *U. pseudoanemones*. So far 9 species of *Urocystis* on the host family Ranunculaceae are recognized from China (Guo 2002).

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BIODIVERSITY INVENTORY OF DICTYOSTELID CELLULAR SLIME MOLDS IN TAIWAN

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Abstract

Dictyostelid cellular slime molds are widely distributed in the world, and they are most numerous and of the greatest variety in forest soils. Taiwan is located in the subtropics with many high mountains. The vegetation is luxuriant and the fungal biodiversity is great.

Dictyostelid cellular slime molds were obtained from soils of various habitats such as forests, grasslands or cultivated fields of Taiwan. Up to date, 17 species and 3 genera have been recorded, namely: *Acytostelium leptosomum*, *Dictyostelium aureo-stipes* var. *aureo-stipes*, *D. brefeldianum*, *D. clavatum*, *D. coeruleo-stipes*, *D. delicatum*, *D. giganteum*, *D. lavandulum*, *D. macrocephalum*, *D. minutum*, *D. monochasioides*, *D. polycephalum*, *D. purpureum*, *D. rhizopodium*, *Polysphondylium pallidum*, *P. pseudo-candidum* and *P. violaceum*.

Ecological distribution of the above 17 species in forest soil of Taiwan and keys for taxonomy are provided.

Key words: Mycetozoa, dictyostelids, *Acytostelium*, *Dictyostelium*, *Polysphondylium*

Dictyostelid cellular slime molds, or dictyostelids, are primarily found in forest soils and humus of both temperate and tropical zones (Singh, 1947; Cavender and Raper, 1965; Cavender, 1973). Taiwan is an island along the western edge of the Pacific Ocean. It resembles a well-developed sweet potato in appearance, and is located across the Tropic of Cancer. Extending 394 km along its longest axis (ca. 25°20'N to 21°55'N) and stretching 140 km at its broadest transection, this island measures about 35,800 km^2 in surface area. In the lowlands, the average temperature is about 26-30℃ in summer and 15-23℃ in winter. The annual rainfall is abundant in the lowlands, usually more than 2600 mm, and the vegetation is varied and luxuriant. Over 50% of the total land surface in Taiwan is covered by forests, which may provide the dictyostelids good growing habitats.

There are many reports on natural forest vegetation analysis in this island (Li, 1963; Hsu, 1971; Huang, 1972; Liu and Liao, 1980; Su, 1984). According to Hsieh et al (1994), 5 principal forest vegetation zones can be distinguished along the altitudinal distribution, as follows:

(1) Costal vegetation: including mangroves, sand-dune plants, and littoral forests.
(2) Lowland vegetation (below 500 m): including *Ficus-Machilus* forests, secondary forests, and grasslands.
(3) Montane vegetation (500 m ~ 2,500 m): including *Machilus-Castanopsis* forests, evergreen oak forests, beech forests, mixed coniferous forests, pine forests, and *Tsuga-Picea* forests.
(4) Subalpine vegetation (2,500 m ~ 3,700 m): including *Abies* pure stands, *Berberis* shrub, some *Quercus* trees, and *Yushania* dwarf bamboo thickets etc.
(5) Alpine vegetation (3,500 m ~ 3,900 m): generally represented by two types of communities, a lower scrub community (ex. *Rhododendron*), and an upper herb community (ex. *Lycopodium*).

Taxanomically dictyostelids are either classified in the order Dictyosteliales, class Dictyosteliomycetes, phylum Dictyosteliomycota, Kingdom Fungi (Hawksworth, et al., 1995; Alexopoulous, et al., 1996), or classified in the subclass Dictyostelia, class Eumycetozoa, subphylum Mycetozoa, phylum Gymnomyxa, Kingdom Protista (Olive, 1975). They are composed of amoeboid vegetative stage, migrating stages and fruiting stage within their life cycle. Amoeboid cells feed selectively on bacteria. The myxamoebae after exhaustion food supply aggregate into pseudoplasmodia, which may migrate on the substratum. After a short period of migration, the pseudoplasmodia differentiate into one or more fruiting bodies (sorocarp). The sorocarp primarily consists of a cellular stalk (sorophore) and a spore mass embedded in slime (sorus).

Dictyostelids were described first by Brefeld in 1869. Up to the present, more than 70 species have been recorded in the world (Raper, 1984; Hagiwara, 1989; Cavender, et al., 1995; Vadell, et al., 1995; Vadell and Cavender, 1998; Swanson, et al., 1999; Cavender and Vadell, 2000). In Taiwan, Hagiwara et al (1992) reported 12 taxa of dictyostelids, namely: *Acytostelium leptosomum* Raper, *Dictyostelium aureo-stipes* var. *aureo-stipes* Cavender, Raper et Norberg, *D. brefeldianum* Hagiwara, *D. giganteum* Singh, *D. lavandulum* Raper and Fennell, *D. macrocephalum* Hagiwara, Yeh et Chien, *D. monochasioides* Hagiwara, *D. polycephalum* Raper, *D. purpureum* Olive, *D. rhizopodium* Raper et Fennell, *Polysphondylium pallidum* Olive, and *P. violaceum* Brefeld. Recently, Lin and Yeh (1999), Hsu et al (2001), Fan and Yeh (2001), and Fan et al (2002) reported 5 newly recorded species, *D. clavatum* Hagiwara, *D. coeruleo-stipes* Raper et Fennell, *D. delicatum* Hagiwara, *D. minutum* Raper, and *P. pseudo-candidum* Hagiwara. The biodiversity of dictyostelid cellular slime molds in Taiwan at present includes: 2 families, 3 genera and 17 species. Ecological distribution (Table 1) and keys for the above 17 species are provided.

Materials and Methods

More than one thousand soil samples were collected from various sites of forest floor, grasslands, and cultivated fields in Taiwan during 1980-2001. They were scraped into plastic bags (ca. 15×25cm). If samples were not plated out immediately after collection, they were stored at low temperatures (5-10℃) for future analyzed. Five to ten grams of each soil samples were processed to isolate dictyostelids either on hay infusion agar according to the Hagiwara method (1971) or on lactose yeast-extract agar according to the Norberg method (1971). *Escherichia coli* cells were used as food sources. Methods for cultivation and observation of dictyostelids were previously described (Hsu et al., 2001). The taxonomic systems of Raper (1941), Raper and Fennell (1967), and Hagiwara (1989, 1992) were followed for identification.

Taxonomic description

Based on Hawksworth et al. (1995), dictyostelids are within the order Dictyosteliales. This order belongs to the class Dictyosteliomycetes of the phylum Dictyosteliomycota. A key to families of the Dictyosteliales is as follows:

1. Sorophores acellular --- Acytosteliaceae
2. Sorophores cellular --- Dictyosteliaceae

1. **Acytosteliaceae** Raper et Quinlan

J. Gen. Microbiol., 18:18, 1958.

Sorocarps usually gregarious or clustered, but sometimes solitary, unbranched, nonphototropic. Sorophores colorless, acellular, very thin. Sori white, globose. Spores hyaline, colorless, globose or elliptical, smooth. Pseudoplasmodia radial or mound-like, centralized or subdivided (Hagiwara, 1989).

Acytostelium leptosomum Raper, Mycologia, 48: 179, 1956.

Seven isolates belong to *Acytostelium* were obtained from five sites in Taiwan (Hagiwara et al., 1992). All of them were tentatively placed in *Acytostelium leptosomum* (detailed data unpublished).

2. **Dictyosteliaceae** Rostafinski

Sluzowce (Mycetozoa), Monografia. Paris. 1875.

Sorocarps solitary, gregarious, clustered, unbranched or irregularly branched, or having monochasium-like branches or whorled branches, phototropic or nonphototropic. Sorophores colorless, or pigmented, cellular, thin to thick. Sori colorless, white, or pigmented, globose. Spores hyaline or translucent, colorless or pigmented, globose or elliptical, smooth, with or without polar granules. Pseudoplasmodia radial or mound-like, centralized or subdivided.

A key to Taiwanese genera of the Dictyosteliaceae is as follows:

1. Sorocarps unbranched, or branched but never have whorled branches -- *Dictyostelium*
2. Sorocarps typically have whorled branches---------------------------- *Polysphondylium*

Dictyostelium Brefeld

Abh. Senckenberg. Naturf. Ges. 7:85-107, 1869.

Sorocarps solitary, gregarious, clustered, or coremiform-like, unbranched or irregularly branched, or having monochasium-like branches, phototropic or non-phototropic. Sorophores colorless, or pigmented, cellular, thin to thick. Sori colorless, white, or pigmented. Spores hyaline or translucent, colorless or pigmented, globose or elliptical, smooth, with or without polar granules. Pseudoplasmodia radial or mound-like, centralized or subdivided.

Key to the taxa of Taiwanese *Dictyostelium*

1. Polar granules absent, or PG (–)
  2. Sori white
    3. Sorocarps small, 0.3-2.5 mm, solitary or gregarious
      4. Sorophores with clavate bases, spores mostly 5.5-6.6×2.8-3.3 μm-- *D. clavatum*
      4. Sorophores with stout bases, spores mostly 6.3-8.5×3.7-4.8 μm ------------------
      --*D. macrocephalum*
    3. Sorocarps large, more than 2.5 mm, typically solitary
      5. Sorocarps mostly 2.5 mm-10 mm --------------------------------- *D. brefeldianum*
      5. Sorocarps very large, 10.0 mm or more ----------------------------- *D. giganteum*
  2. Sori purple --- *D. purpureum*
1. Polar granules present, or PG (+)
    6. Sorocarps small (-2mm),
      7. Sorocarps minute, less than 1 mm, typically coremiform-like --- *D. polycephalum*
      7. Sorocarps more than 1 mm, not coremiform-like ---------------------- *D. minutum*
    6. Sorocarps medial (-3.5mm) or large (-6mm),
      8. Sorocarps medial (-3.5mm), with monochasium-like branches-*D. monochasioides*
      8. Sorocarps large (-6mm), without monochasium-like branches
        9. Sori white to yellowish white, bases clavate to bulbous
          10. Sorophores colorless when cultivated in the dark------------- *D. delicatum*
          10. Sorophores yellow when cultivated in the dark------------- *D. aureo-stipes*
          ---var. *aureo-stipes*
        9. Sori white to cream, brownish olive or lavender, bases typically digitate
          11. Sori white to cream, sorophores bluish-------------------*D. coeruleo-stipes*
          11. Sori brownish olive or lavender
            12. Sori shading from yellow to brownish olive, sorophores tinted with purple, tips typically capitate----------------------------- *D. rhizopodium*
            12. Sori lavender, sorophores lavender-purple, tips obtuse to clavate-----
            ---*D. lavandulum*

Polysphondylium Brefeld
Unters. Gesammtgeb. Mykol. 6:1-34, pl.1-2, 1884

Sorocarps solitary, gregarious, or clustered, having whorled branches, phototropic or nonphototropic. Sorophores colorless, or pigmented, cellular, thin. Sori colorless, white, or pigmented, globose. Spores hyaline or translucent, colorless or pigmented, elliptical, smooth, usually with polar granules. Pseudoplasmodia radial or mound-like, centralized or subdivided.

Key to the taxa of Taiwanese *Polysphondylium*

1. Sori violaceous purple, sorophore tips clavate ----------------------------- *P. violaceum*
1. Sori colorless or white, sorophore tips acuminate
    2. Terminal segments of sorophores often elongated, spore elongate-elliptical ---------
    ---*P. pseudo-candidum*
    2. Terminal segments of sorophores never elongated, spore elliptical--------*P. pallidum*

Table 1. Ecological distribution of dictyostelid cellular slime molds in Taiwan

Taxa	N	C	S	E	Alt. (m)	Veg.
Acytostelium leptosomum		+	+		below 500	L
Dictyostelium aureo-stipes var. *aureo-stipes*	+	+	+		below 500	L
D. brefeldianum	+	+	+	+	50~2,600	L、M、S(Pi)
D. clavatum	+				1,650	M(Mi)
D. coeruleo-stipes	+				400	L
D. delicatum	+	+			500~1,650	L(Gr)、M(Mi)
D. giganteum	+	+	+	+	50~1,500	L、M(Br)
D. lavandulum		+	+		50~600	L
D. macrocephalum	+	+	+	+	50~2,950	L、M、S(Qu)
D. minutum	+				1650	M(Mi)
D. monochasioides	+	+	+		50~1,000	L、M(Br)
D. polycephalum	+		+		100~500	L
D. purpureum	+	+	+		50~1,500	L、M(Br)
D. rhizopodium	+	+			100~400	L
Polysphondylium pallidum	+	+	+	+	50~2,700	L、M、S(Pi)
P. pseudo-candidum	+				600	M(Br)
P. violaceum	+	+	+	+	50~2,650	L、M、S(Pi)

N: Northern Taiwan, C: Central Taiwan, S: Southern Taiwan, E: Eastern Taiwan; Alt.: Altitude; Veg.: Vegetation types; L: Lowland vegetation; M: Montane vegetation; S: Subalpine vegetation; Br: Broad-leaved forests; Gr: Grasslands; Mi: Mixed coniferous forests; Pi: *Pinus taiwanensis*; Qu: *Quercus spinosa*.

Discussion

In this preliminary survey, we found that most of the dictyostelids are isolated from lower to mid-high elevation. Among the described 17 taxa, *D. macrocephalum*, *D. brefeldianum*, *P. pallidum*, and *P. violaceum* are the most common species. Their habitats were found from lowlands to subalpine vegetation. *Acytostelium leptosomum*, *D. delicatum*, *D. lavandulum*, *D. polycephalum*, and *D. rhizopodium* are less common in the study areas. However, *D. clavatum*, *D. minutum*, *D. coeruleo-stipes*, and *P. pseudo-candidum* at present are very rare and limited distribution in Taiwan.

D. macrocephalum is also widely distributed in lowlands of Nepal, Thailand, Pakistan, Oman, New Guinea and southernmost regions of Japan (Hagiwara et al., 1985; Hagiwara, 1991, 1998). It has been reported only once outside Asia, from tropical forest of Peru (Landolt and Stephenson, 1991). Therefore, it seems that this is a common species of the subtropical and tropical regions in and around Asia. But in Taiwan, it distributes from lowlands to cool temperate forest (ca. 2,950m). This indicates that Taiwan may provide diversified ecological niches for *D. macrocephalum*.

D. monochasioides is widely distributed in broad-leaved forest soils of Taiwan. It has been obtained from Japan, Nepal, New Guinea (Hagiwara, 1989), Peru (Landolt and Stephenson, 1991) and Oman (Hagiwara, 1991).

D. aureo-stipes var. *aureo-stipes* is very similar in appearance to *D. delicatum*, except for the former species has yellow-pigmented sorophores when cultivated in the dark. *D. aureo-stipes* var. *aureo-stipes* has a worldwide distribution in temperate and tropical regions (Cavender et al., 1979; Cavender and Lakhanpal, 1986), but *D. delicatum* was discovered in Japan, Nepal (Hagiwara, 1989) and Taiwan.

D. lavandulum and *D. rhizopodium*, the digitate-based dictyostelids, are not common in Taiwan. According to Raper and Fennell (1967), and Hagiwara (1989), both species were distributed in America, Japan and Southeast Asia.

Cavender and Lakhanpal (1986) studied the distribution of dictyostelids in forest soils of India. They found that *D. minutum* was confined to the relatively narrow band of temperate deciduous forest from 1,400 m to 2,400 m. This species was also obtained only from temperate mixed forest at 1,650 m of northern Taiwan. This agrees with their report.

At present *D. clavatum* is distributed in Nepal and Taiwan. It was first isolated from 1,710 m to 1,900 m in mixed forest of Mt. Phulchoki area of Nepal by Hagiwara (1992). The habitats of *D. clavatum* in Nepal are very similar to Taiwan in which it is only obtained from a mixed forest at 1,650 m.

D. coeruleo-stipes, another kind of digitate-based dictyostelid cellular slime mold, is recorded first from Asia. This species is rare and only found in lowland of northern Taiwan. Raper and Fennell (1967) first discovered this species in forest soils of Florida and Mexico in North America.

So far *P. pseudo-candidum* is obtained from forest soils of Okinawa, Japan and broad-leaved forest soils of Taiwan. Hagiwara (1989) considered that this species appears to be a subtropical species.

The remaining 7 species obtained from Taiwan are almost widely distributed around the world (Hagiwara, 1989; Cavender, et al., 1995; Swanson, et al., 1999). We believe that the biodiversity of the dictyostelid cellular slime molds would be more abundant if more investigations are conducted, especially for the forest soils from central and eastern montane areas in Taiwan.

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A NEW PENIOPHORA (BASIDIOMYCOTA) FROM PARAGUAY

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Abstract: *Peniophora fulvocinerea* sp. nov. found on decaying wood in a tropical rain forest at Itabó Biological Reservation in Paraguay is described and illustrated.

Key words: corticioid fungi, South America, *Duportella*

During a survey of the aphyllophoraceous fungi of Paraguay carried out in the last ten years, noteworthy specimens were found, one of which is herein described. Previous knowledge on these fungi has been summarized by Popoff & Wright (1998).

Peniophora fulvocinerea Popoff & J. E. Wright *sp. nov.*

Basidiocarpo resupinato, arcte adnato, 180-250 µm crass.; hymenio laevi, rimoso, sub lente velutino per cystidiis procurrentibus, humido fulvo-cinereo, fulvo vel bubalino; margo

sterile, abrupte vel sutiliter fibrilloso, tenuior. Systema hypharum mono-dimiticis, hyphis generativis fibulatis, tenui tunicatis, hyalinis vel flavis, 1.2-3 µm crass., hyphis crassitunicatis flavis vel pallide brunneis, 2-3-(4) µm crass.; subiculo absens vel tenuissimo, brunneis ex hyphis conglutinatisque; subhymenio incrassato cystidis inclusis, hyphis verticalibus dispositis, arcte contiguis, pseudoparenchymatis. Cystidiis numerosis, incrustatis, conicis, acutis, 28-50-(55) x 6-9-(11) µm ab hymenio procurrentibus usque ad 30 µm, crassitunicatis brunneisque, interdum 1-2 septatis, bi- vel multiradicatis, in aetate inmersis. Gloeocystidiis infrequentibus, subcylindricis-fusoideis, leviter constrictis, 35-50 x 6-7,5(-9) µm, tenuitunicatis vel leviter crassitunicatis. Basidiis subcylindricis, plus minus constipatis, sinuosis, 22-35 x 4.2-5.3 µm, 4-sterigmatiis. Sporis globosis vel subglobosis, 4.2-5.3 x 4.2-4.8 µm, parietis aliquantum incrassatis, laevis, acyanophilis, inamyloideis.

Holotypus: PARAGUAY, Alto Paraná, Reserva Biológica Itabó, “en selva”, 09.X.1990, leg.: O. Popoff, G. Caballero & M. Gullón 773 (in Herb. BAFC, Isotypus CTES, LY et O).

Fruitbody resupinate, closely adnate, 180-250 µm thick, thinning out towards the sterile margin which is abrupt or partly finely fibrillose, not especially differentiated; hymenium smooth, cracked, velvety under the lens due to abundant projecting cystidia, tawny to buff. Hyphal system mono-dimitic, hyphae with clamps, thinwalled, hyaline to slightly yellowish, 1.2-3 µm wide, to thickwalled, yellowish or pale brown, more strongly pigmented in the older layers, 2-3 (4) µm wide; subiculum lacking or present as a very thin layer, subhymenium thickening with enclosed cystidia, hyphae vertically arranged, closely united forming a pseudoparenchymatic tissue. Cystidia numerous, very conspicuous, incrusted, conical, acute, 28-50 (55) x 6-9 (11) µm, projecting up to 30 µm above the hymenium, becoming thickwalled and brown, sometimes 1-2 septet, basely with 2 to several basal-roots, the older ones completely immersed. Gloeocystidia scarce, subcylindric-fusoid, 35-50 x 6-7.5 (-9) µm, slightly constricted near the apex, thinwalled to slightly thickwalled in the basal part, apex obtuse, sometimes with schizopapilla, SA-. Basidia subcylindrical, more or less constricted, sinuous, 22-35 x

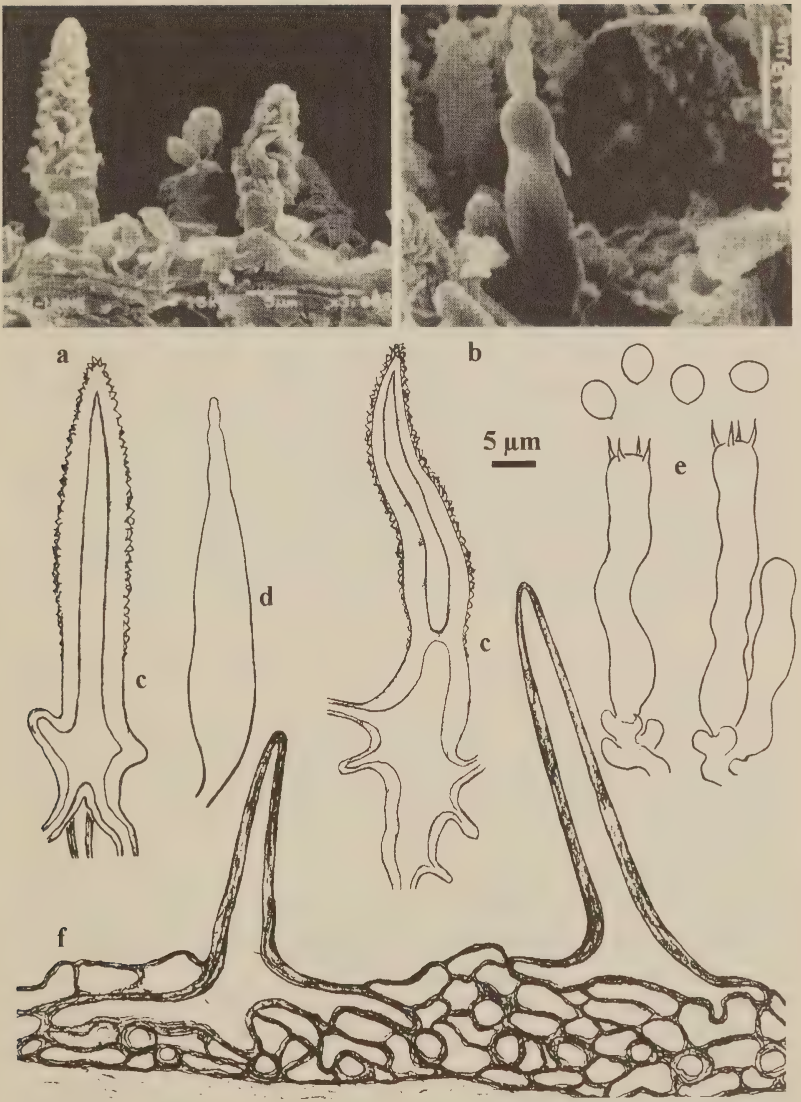

Fig. 1, *Peniophora fulvocinerea* sp. nov.; **a**, **b**, scanning electron micrographs showing incrusted cystidia and gloeocystidia; **c**, incrusted cystidia, **d**, gloeocystidia, **e**, basidia and spores, **f**, cystidia immersed in subiculum.

4.2-5.3 µm, with 4 sterigmata. Spores globose or subglobose, 4.2-5.3 x 4.2-4.8 µm, with somewhat thickened walls, smooth, small apiculus, acyano-philous, inamyloid.

Etym: the specific epithet refers to the colour of the hymenophore.

Remarks: the hyphae are closely interwoven, pseudoparenchymatic in thin sections and, those of the subiculum, densely agglutinated. Clamps are very difficult to find and can be observed toward the margin of the fruitbody. There are three similar species to *Peniophora fulvocinerea*; they are a) *Peniophora ovalispora* Boidin, Lanq. and Gilles has ovoid spores 3.5-4-5-6 x 3.2-4-4.5 µm, shorter incrusted cystidia (25-30 µm long) and smaller gloeocystidia (22-35 x 3.5-6 µm); b) *Duportella miranda* Boidin, Lanq. and Gilles has subovoid spores 5-6.5 x 3.8-4.7 µm and numerous gloecystidia, 35-60-85 x 10-12 µm, SA+; and c) *Duportella sphaerospora* G. Cunn. has notably larger, globose spores (10-12 x 9-10 µm). The last species have been described by Cunningham (1963) from New Zealand, and the two previous species have been described by Boidin et al. (1991), from Reunion.

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A NEGLECTED PUBLICATION BY ELIAS FRIES – ANTECKNINGAR ÖFVER DE I SVERIGE VÄXANDE ÄTLIGA SVAMPAR, 1836

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ABSTRACT

Fries's *Anteckningar* is fully indexed, and the nomenclatural novelties are annotated. These include: ten new species (*Agaricus colossus, Hydnum politum, Hydnum scabrosum, Hygrophorus arbustivus, Hygrophorus penarius, Polyporus politus, Polyporus spectabilis, Russula lepida, Russula vesca*, and *Sparassis laminosa*); twenty new combinations (*Agaricus garidellii, Amanita procera, Amanita solitaria, Hygrophorus ceraceus, Hygrophorus coccineus, Hygrophorus eburneus, Hygrophorus ovinus, Hygrophorus pratensis, Hygrophorus pudorinus, Hygrophorus puniceus, Marasmius oreades, Marasmius peronatus, Marasmius scorodonius, Marasmius urens, Pluteus bombycinus, Pluteus campestris, Pluteus cretaceus, Pluteus speciosus, Polyporus artemidorus*, and *Russula virescens*); and one new name (*Marasmius foeniculaceus*).

KEYWORDS: nomenclature, systematics, macrofungi, edible fungi

INTRODUCTION

In 1836, Fries published a set of eight theses (in Swedish) concerning edible fungi growing in Sweden, *Anteckningar öfver de i Sverige växande ätliga Svampar* (Fries 1836; see also Stafleu & Cowan 1976, p. 884). Like the numerous other theses defended by pupils of Fries, authorship is to be attributed to Fries alone, "who was himself responsible for the text" (Stafleu & Cowan 1976, p. 882, entry #1869; and see also p. 886, entry #1886). The first four theses (pp. 1–32) contain a wide-ranging general discussion of edible fungi, while the second four (pp. 33–68) provide a descriptive Catalogue ('Förteckning') of 66 individual edible species. The Catalogue is organised into four major groups under Swedish names with their Latin equivalents ('SKIFLINGAR (Agaricini)', 'PIP- och TAGG-SVAMPAR (Polyporei och Hydnei)', 'FINGER-SVAMPAR (Clavariei)', and 'MORKEL-ARTADE SVAMPAR (Helvellei)'). Within these major groups, the species are further categorised into sub-groups with Swedish names and their Latin equivalents. The Latin names are mostly in the plural (e.g., 'AMANITAE', 'PRUNULI', 'CLAVARIAE ramosae', 'MORCHELLAE', 'PEZIZAE'), but a few are in the singular (e.g., 'BOLETUS', 'POLYPORUS', 'HYDNUM'). Some of the sub-groups are treated at an infrageneric level, with the species in several sub-groups sharing a common generic name (e.g., *Agaricus, Clavaria*). Others are treated at the generic level, with the sub-group's Latin name employed, in full or abbreviated form, as the generic moiety of the binomials of the included species.

In his *Epicrisis systematis mycologici* (Fries 1838), Fries made nine citations of the *Anteckningar*, somewhat cryptically abbreviated as either "Fr. Fung. esc." or merely "Fr. esc."; and in his

Hymenomycetes europaei (Fries 1874), he made two citations, abbreviated as "Fr. Anteckn. ätl. sv." (see INDEX TO FRIES'S ANTECKNINGAR ÖFVER DE I SVERIGE VÄXANDE ÄTLIGA SVAMPAR, below). These citations refer to just a few of the nomenclatural novelties first published in the *Anteckningar*. Over the subsequent years, the nomenclatural contribution of this publication has been almost universally overlooked or ignored.

This paper indexes all the fungal species and varieties mentioned in the *Anteckningar* and annotates the nomenclatural novelties. Very few of the names in the *Anteckningar* are provided with authorities; these have been ascertained by reference to the citations provided in Fries's other major publications (e.g., see REFERENCES, below), cross-checked against the primary literature, and revised and corrected where necessary.

NEW SPECIES

Eight of the 66 species treated in detail in the Catalogue are new species: *Hydnum politum* (p. 62, as 'H. politum'), *Hydnum scabrosum* (p. 62, as 'H. scabrosum'), *Hygrophorus arbustivus* (p. 46, as 'H. arbustivus'), *Hygrophorus penarius* (p. 45, as 'H. penarius'), *Polyporus politus* (p. 59, as 'P. politus'), *Russula lepida* (p. 50, as 'R. lepida'), *Russula vesca* (p. 51, as 'Russ. vesca'), and *Sparassis laminosa* (p. 64, as 'Sp. laminosa').

Two additional new species are introduced elsewhere in the publication: *Agaricus colossus* (p. 38, as 'A. colossus') is described in detail in a footnote; and *Polyporus spectabilis* (p. 61, as 'P. spectabilis') is described briefly in Observations ('Anmärk.') on the genus *Polyporus*. This species, from oak trunks in Sweden, is clearly a different taxon from the *Polyporus spectabilis* subsequently described by Fries (1851, p. 48) from the ground in South Carolina. If the description of *Polyporus spectabilis* Fr. 1836 is deemed to be sufficiently detailed to constitute a valid publication — the protologues of many accepted species are no better! — *Polyporus spectabilis* Fr. 1851 must be treated as an illegitimate later homonym.

NEW COMBINATIONS

(For the basionyms of new combinations, see INDEX TO FRIES'S ANTECKNINGAR ÖFVER DE I SVERIGE VÄXANDE ÄTLIGA SVAMPAR, below.)

Nine of the 66 species in the Catalogue involve the transfer of earlier names to new genera: *Hygrophorus eburneus* (p. 45, as 'H. eburneus'), *Hygrophorus pratensis* (p. 46, as 'H. pratensis'), *Marasmius oreades* (p. 52, as 'M. oreades'), *Marasmius scorodonius* (p. 53, as 'M. scorodonius'), *Pluteus bombycinus* (p. 34, as 'Pluteus bombycinus'), *Pluteus campestris* (p. 34, as 'Pl. campestris'), *Pluteus cretaceus* (p. 34, as 'Pluteus cretaceus'), *Pluteus speciosus* (p. 34, as 'Pluteus speciosus'), and *Russula virescens* (p. 50, as 'Russula virescens').

There are eleven additional new combinations elsewhere in the publication: *Agaricus garidellii* (p. 39, as 'A. garidelli'), *Amanita procera* (p. 33, as 'A. procera'), *Amanita solitaria* (p. 33, as 'A. solitaria'), *Hygrophorus ceraceus* (p. 45, as 'H. ceraceus'), *Hygrophorus coccineus* (p. 45, as 'H. coccineus'), *Hygrophorus ovinus* (pp. 45, 47, as 'H. ovinus'), *Hygrophorus pudorinus* (p. 46, as 'H. pudorinus'), *Hygrophorus puniceus* (p. 45, as 'H. puniceus'), *Marasmius peronatus* (p. 52, as 'M. peronatus'), *Marasmius urens* (p. 52, as 'M. urens'), and *Polyporus artemidorus* (p. 60, as 'P. artemidorus'). The combination *Polyporus artemidorus* appears in a footnote in which it is cited as a synonym of *Polyporus confluens*; it must therefore be treated as an invalid name. The other combinations all occur in general discussion and apparently constitute valid names.

A NEW NAME

The binomial *Marasmius foeniculaceus* (p. 52, as 'M. foeniculaceus') appears in general discussion of 'MARASMII'. It might well be interpreted as a nomen nudum, since it lacks any description and there is no known antecedent use of the epithet. However, reference to Fries's subsequent treatment of this name (Fries 1838, p. 374; 1874, p. 466) indicates that it was introduced as a nomen novum for *Agaricus peronatus* β *tomentellus* sensu Lasch 1828, non (Schumach.:Fr.) Fr. 1821. (In *Hymenomycetes europaei* (Fries 1874, p. 466), the citation of 'Agaricus *Fr. Ant. ätl. Sv. p. 52*' under *Marasmius foeniculaceus* is obviously an error; the first publication of this epithet (Fries 1836, p. 52) was unequivocally in *Marasmius*, not *Agaricus*.)

AMBIGUITIES

The generic abbreviation 'A.' in the two names *A. procera* and *A. solitaria* (p. 33, under 'AMANITAE') is perhaps slightly ambiguous, but the alteration of the epithets to the feminine gender indicates that *Amanita* is intended rather than *Agaricus*. (Compare this with the earlier passing mention of '*Agaricus procerus*' (p. 20), which has the epithet correctly in the masculine gender.) These two names have therefore been interpreted as new combinations in *Amanita*.

The species *Agaricus quietus* (p. 49, as 'Ag. s. Lactarius quietus') and *Agaricus volemus* (p. 49, as 'Agar. Lactarius volemus') have not been interpreted as new combinations in *Lactarius*. The orthography of these names indicates that in the *Anteckningar* Fries was still treating *Lactarius* as a tribus within the genus *Agaricus*. This interpretation is reinforced by his treatment of the other two species included under 'LACTARII', *Agaricus deliciosus* and *Agaricus piperatus*, which are presented simply and unequivocally as *Agaricus* species (although combinations in *Lactarius* had already been made for both these species, by Gray and Persoon, respectively). The new combinations, *Lactarius quietus* and *Lactarius volemus* were subsequently published in the *Epicrisis* (Fries 1838, pp. 343–344).

The taxon *Agaricus pratensis* β *ericeus*, referred to in a footnote (p. 45, as '*Ag. pratensis β. ericeus* S. M.'), is probably a lapsus calami for *Agaricus pratensis* β *ericosus* Fr.:Fr. 1821, since the initials 'S. M.' refer to '*Systema Mycologicum*'. Alternatively, *Agaricus pratensis* β *ericeus* could be interpreted as a new name (?based on *Agaricus ericeus* With. 1796, nom. illegit., non Pers.:Fr. 1801, nec Bull. 1783–84 — Fries (1821, p. 100) cited Withering's taxon in synonymy under *Agaricus pratensis* β *ericosus*).

In general discussion (p. 11), a list of examples of "stinking" species ('stinkande arter') includes the name '*Agaricus l.*' The identity of this species must remain speculative, but *Agaricus lascivus* Fr.:Fr. 1821 [≡ *Tricholoma lascivum* (Fr.:Fr.) Gillet 1874] has been suggested (E.Horak, pers. comm.) as a possible candidate.

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INDEX TO FRIES'S *ANTECKNINGAR ÖFVER DE I SVERIGE VÄXANDE ÄTLIGA SVAMPAR*

« **bold type** » = names and page references of species described in detail in the Catalogue; and citations of nomenclatural novelties published in the *Anteckningar*.
« normal type » = names appearing in general discussion, Observations, and footnotes.
« (parentheses) » = page references to general discussion, Observations, and footnotes.
[Later citations] = direct references to the *Anteckningar*, in *Epicrisis systematis mycologici* [*ESM*:] and *Hymenomycetes europaei* [*HE*:].
Basionyms cited for all comb. nov. published in the *Anteckningar*.

Name [Authority] **Page(s)** **[Later citations]**

A

acetabulum, *Peziza* [L.:Fr. 1753] (68)
arbustivus*, *Hygrophorus **[Fr. 1836, sp. nov.]** **46** [*ESM*: 323]
artemidorus, *Polyporus* **[(Lenz) Fr. 1836, comb. nov., nom. inval.]** (60)
≡ *Boletus artemidorus* Lenz 1831
aurantiacus, *Cantharellus* [(Wulfen:Fr.) Fr. 1821] (51)
aurantius, *Polyporus* [(Schaeff.) Trog 1832] (60)
aureus*, *Boletus [Schaeff. 1774] **55**
auricula, *Agaricus* [(Duby:Fr.) DC. 1815] (39)

B

bombycinus*, *Pluteus **[(Schaeff.:Fr.) Fr. 1836, comb. nov.]** **34**
≡ *Agaricus bombycinus* Schaeff.:Fr. 1774
botrytis*, *Clavaria [Pers.:Fr. 1797] (19), **65**
bovinus*, *Boletus [L.:Fr. 1753] **55**

C

caesareus, *Agaricus* [Scop.:Fr. 1772] (3)
campestris, *Agaricus* [L.:Fr. 1753] (20)
campestris*, *Pluteus **[(L.:Fr.) Fr. 1836, comb. nov.]** **34**
≡ *Agaricus campestris* [L.:Fr. 1753]
cardarella, *Agaricus* [Fr.:Fr. 1821] (39)
caryophyllaeus [sic], Agaricus – See *caryophylleus*, *Agaricus*
caryophylleus [as '*caryophyllaeus*'], *Agaricus* [Schaeff. 1774] (52)
ceraceus, *Hygrophorus* **[(Wulfen:Fr.) Fr. 1836, comb. nov.]** (45)
≡ *Agaricus ceraceus* Wulfen:Fr. 1781
cibarius*, *Cantharellus [Fr.:Fr. 1821] **51**
coccineus, *Hygrophorus* **[(Schaeff.:Fr.) Fr. 1836, comb. nov.]** (45)
≡ *Agaricus coccineus* Schaeff.:Fr. 1774
colossus, *Agaricus* **[Fr. 1836, sp. nov.]** (38)
columbetta, *Agaricus* [Fr.:Fr. 1821] (39)
confluens, *Boletus* [Alb. & Schwein.:Fr. 1805] (59)
confluens*, *Polyporus [(Alb. & Schwein.:Fr.) Fr. 1821] **59**
conica, *Morchella* [Pers.:Fr. 1818] (66)
contortus, *Agaricus* [Bull.:Fr. 1780–81] (42)
coralloides*, *Hydnum [Scop.:Fr. 1772] **63**
corrugatum, *Hydnum* [Fr.:Fr. 1818] (63)
cretaceus*, *Pluteus **[(Bull.:Fr.) Fr. 1836, comb. nov.]** **34**
≡ *Agaricus cretaceus* Bull.:Fr. 1788
crispa*, *Helvella [(Scop.:Fr.) Fr. 1822] **67**
crispa*, *Sparassis [(Wulfen:Fr.) Fr. 1821] **64**
cristatus*, *Polyporus [(Schaeff.:Fr.) Fr. 1821] **60**

D

deliciosa*, *Morchella [Fr.:Fr. 1822] (12), **66**
deliciosus*, *Agaricus [L.:Fr. 1753] (11, 12), **47**
≡ *Lactarius deliciosus* (L.:Fr.) Gray 1821

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E

eburneus*, *Hygrophorus **[(Bull.:Fr.) Fr. 1836, comb. nov.]** ... **45**
≡ *Agaricus eburneus* Bull.:Fr. 1782–83
edulis*, *Boletus [Bull.:Fr. 1781–82] ... (20), **56**
elata, *Morchella* [Fr.:Fr. 1822] ... (67)
emetica, *Russula* [(Schaeff.:Fr.) Pers. 1796] ... (51)
equestris*, *Agaricus [L.:Fr. 1753] ... (30), **38**
ericeus [sic], Agaricus pratensis β – See *ericosus*, *Agaricus pratensis* β
ericosus [as '*ericeus*'], *Agaricus pratensis* β [Fr.:Fr. 1821] ... (45)
{**?or**: *Agaricus pratensis* β *ericeus* **Fr. 1836, nom. nov.**}
{≡ *Agaricus ericeus* With. 1796, nom. illegit.}
erinaceus*, *Hydnum [Bull.:Fr. 1780–81] ... (30), **63**
eryngii, *Agaricus* [DC.:Fr. 1815] ... (39)
esculenta*, *Helvella [Pers.:Fr. 1800] ... **67**
esculenta*, *Morchella [(L.:Fr.) Pers. 1801] ... **66**
esculentus*, *Agaricus [Wulfen:Fr. 1781] ... **41**
esculentus, *Phallus* [L.:Fr. 1753] ... (66)

F

flava*, *Clavaria [Schaeff.:Fr. 1774] ... **65**
flavovirens*, *Agaricus [Pers.:Fr. 1801] ... **38**
flavus, *Boletus* [With. 1796] ... (54)
foeniculaceus, *Marasmius* **[Fr. 1836, nom. nov.]** ... (52) [*ESM*: 374; *HE*: 466]
≡ *Agaricus peronatus* β *tomentellus* Lasch 1828, nom. illegit.
fomentarius, *Polyporus* [(L.:Fr.) G.Mey. 1818] ... (4)
fragrans*, *Agaricus [With.:Fr. 1792] ... **40**, (45)
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fusipes*, *Agaricus [Bull.:Fr. 1782–83] ... **41**

G

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garidelli [sic], Agaricus – See *garidellii*, *Agaricus*
garidellii, *Agaricus* **[(Paulet) Fr. 1836, comb. nov.**, as '*garidelli*'] ... (39)
≡ *Hypophyllum garidellii* Paulet 1793
georgii, *Agaricus* [L. 1753] ... (36)
giganteus, *Agaricus* [Sibth.:Fr. 1794] ... (40)
giganteus, *Polyporus* [(Pers.:Fr.) Fr. 1815] ... (61)
granulatus*, *Boletus [L.:Fr. 1753] ... **55**

H

hepatica*, *Fistulina [(Schaeff.:Fr.) Sibth. 1794] ... (12), **58**
hypothejus, *Agaricus* [Fr.:Fr. 1818] ... (45)
hypoxylon, *Sphaeria* [(L.:Fr.) Pers. 1796] ... (21)

I

imbricatum*, *Hydnum [L.:Fr. 1753] ... (30), **61**
impudicus, *Phallus* [L.:Pers. 1753] ... (11, 21)

L

l. [?], *Agaricus* ... (11)
?≡ *Agaricus lascivus* Fr.:Fr. 1821
laevigatum, *Hydnum* [Sw.:Fr. 1810] ... (62)
laminosa*, *Sparassis **[Fr. 1836, sp. nov.]** ... **64** [*ESM*: 570; *HE*: 666]
lepida*, *Russula **[Fr. 1836, sp. nov.]** ... **50** [*ESM*: 355]
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luridus, *Boletus* [Schaeff.:Fr. 1774] ... (9, 11, 56)
luteus*, *Boletus [L.:Fr. 1753] ... (12, 18), **54**

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M

maculatus, *Agaricus* [Alb. & Schwein.:Fr. 1805] ....(42)
melleus, *Agaricus* [Vahl:Fr. 1790] ....(41)
mouceron*, *Agaricus [Bull. 1783] **36**
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N

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O

olivaceoalbus, *Agaricus* [Fr.:Fr. 1815] ....(45)
oreades*, *Marasmius **[(Bolton:Fr.) Fr. 1836, comb. nov.]** **52**
≡ *Agaricus oreades* Bolton:Fr. 1792
ostreatus*, *Agaricus [Jacq.:Fr. 1774] ....(29), **42**
ovinus, *Hygrophorus* **[(Bull.:Fr.) Fr. 1836, comb. nov.]** ....(45, 47)
≡ *Agaricus ovinus* Bull.:Fr. 1793
ovinus*, *Polyporus [(Schaeff.:Fr.) Fr. 1821] ....(19), **59**

P

pachypus*, *Boletus [Fr.:Fr. 1815] **56**
pallidus, *Agaricus* [Schaeff. 1774, nom. illegit.] ....(37)
pallidus, *Lactarius* [Pers.:Fr. 1797] ....(48)
pargamenus [sic], Agaricus – See *pergamenus*, *Agaricus*
penarius*, *Hygrophorus **[Fr. 1836, sp. nov.]** .... **45** [*ESM*: 321]
pergamenus [as '*pargamenus*'], *Agaricus* [Sw.:Fr. 1809] ....(48)
perlata, *Peziza* [Fr.:Fr. 1822] ....(68)
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≡ *Agaricus peronatus* Bolton:Fr. 1788
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  ≡ *Agaricus solitarius* Bull.:Fr. 1780–81
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THE ITALIAN CHECKLIST OF MACROFUNGI: DISTRIBUTION OF SELECTED TARGET SPECIES IN SIENA PROVINCE, ITALY

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Abstract

The Working Group for Mycology of the Italian Botanical Society (SBI) proposed a preliminary check-list of Italian macrofungi including 25 species uniformly distributed in Italy and easy to indentify. Later the European Mediterranean Mycological Confederation (CEMMae) proposed the census of 43 species (two of which correspond to the SBI list). Finally the SBI Working Group for Mycology and the CEMMae decided to join their efforts and a list of 66 taxa was proposed as a starting point to evaluate their distribution in Mediterranean countries. Recently the Italian Ministry of Environment funded the project of check-list of Italian fungi and consequently the investigations in many regions were enlarged. In the frame of this project, data on the spatial and temporal distribution of macrofungi in Siena Province (Tuscany, C. Italy) are reported in this paper.

Key words: mycetes, mapping, Mediterranean area, Tuscany

Introduction

Study of the distribution of fungi, including the most common species, began in Europe in relatively recent times. The first important contribution was made by Kreisel at the Second European Mycological Congress in Prague, 1960, when he discussed the needs that fungi should be mapped throughout Europe. The paper by Lange (1974) was a major result of Kreisel's proposal as well as a stimulus for countries (mainly Mediterranean) who did not take part in the project. In Italy, at the end of the '70s Professor Govi of the *Unione Micologica Italiana* (UMI) tried to initiate a national-scale research, but the idea of a census was greeted with little enthusiasm by the scientific community. Despite repeated encouragement and reminders form the international scientific community, Italy failed to organise the coordination necessary to implement a project of such scale and importance until the '90s.

A new appeal launched by the European Council for Conservation of Fungi (ECCF) in the nineties was followed by a series of working meetings and conventions in Italy. In a very short time, effective collaborations was created between the Working Group for Mycology of the Italian Botanical Society (SBI) and some mycological amateur groups such as *Associazione Micologica Bresadola* (AMB) and *Unione Micologica Italiana* (Bellù & al. 1991; Bellù 1992; Bellù & Rossi 1994; Laganà & al. 1996; Monti & Ansaldi 1996; Onofri 1994; Perini & al. 1993, 1999a; Venturella 1991a, 1991b).

The SBI Working Group for Mycology proposed a census of Italian macrofungi covering 25 species chosen on the basis of uniform distribution throughout Italy and easy identification and, subsequently, a contribution on this topic was published by Venturella & al. 1999. In parallel the European Mediterranean Mycological Confederation (CEMMae) proposed a similar project based on 43 taxa, most of which did not coincide with the former list of 25 (with the exception of *Amanita caesarea* and *A. phalloides*) because they were chosen on the basis of Mediterranean distribution and representation. Finally the SBI Working Group for Mycology and the CEMMae decided to join their efforts and a list of 66 taxa was proposed to evaluate their distribution in Mediterranean countries. This list is a starting point for studying the distribution of fungal species in Mediterranean countries that is an objective of the recently established Commission on Fungi of Organization for the Phyto-Taxonomic Investigation in the Mediterranean Area (OPTIMA) (Onofri & Venturella, 1999).

In order to contribute to the knowledge of macrofungi distribution in Mediterranean area this paper provides data on the cartographic, altitudinal and temporal distribution of the 66 taxa belonging to the SBI and CEMMae list. The data here reported arise from ca. 30 years of mycocoenological and - floristic investigations in the province of Siena (C. Tuscany) (Barluzzi & Bianciardi 1970; Barluzzi & al. 1978; Barluzzi et al. 1986; Barluzzi & al. 1992; Barluzzi & al. 1997; De Dominicis & al. 1983; Laganà & al. 2000; Perini et al. 1999b; Salerni et al. 1998; Salerni & Laganà 2000).

Materials and method

Periodical investigations were made in the territories of the province of Siena in order to report the habitats, fruiting periods, altitude belt and site of collection for each investigated taxon. The maps are based on the IGM Map of Italy (1:50,000 scale) with reference to Greenwich, more times subdivided in order to have grids of about 9 km^2. This grid was georeferenced in Gauss Boaga (Rome 40) coordinates, within a GIS (ESRI, Arcviw 3.1). The location of each species was plotted by means of the digitalization of a point theme. All features of this theme, which represents the location of each fungal species, were put in the centre of the grid squares. The scientific binomials and trinomials are listed mainly according to Arnolds & al. (eds.) (1995) and to Courtecuisse & Duhem (1994) for *Amanita caesarea, Chroogomphus fulmineus, Cortinarius aleuriosmus, Hygrophorus latitabundus, H. roseodiscoideus, Lactarius atlanticus, Leccinum lepidum, Marasmius alliaceus, Omphalotus olearius, Pseudohydnum gelatinousm, Russula seperina, Tricholoma bresadolanum* and *T. squarrulosum*); Basso (1999) for *Lactarius ilicis* and *Lactarius mediterraneensis* and Candusso (1997) for *Hygrophorus marzuolus.* Abbreviation of authors' names are according to Brummitt & Powell (eds., 1992). Specimens are kept in the *Herbarium Universitatis Senensis* (SIENA).

Results

*Amanita caesarea (*Scop.) Pers.

Chorology: June, September-November

Altitudinal range: 0-600 m

Habitat: woody areas dominated by *Calluna vulgaris* (L.) Hull; woody areas dominated by *Castanea sativa* Miller; mixed wood of *Pinus nigra* Arnold; woody areas dominated by *Quercus ilex* L.; mixed wood of *Quercus cerris* L. and *Castanea sativa* Miller; mixed wood of *Quercus cerris* L., *Q. pubescens* Willd and *Q. ilex* L.

Bosco di Lecceto (Siena) 296123; Selvaccia (Siena) 296123; La Croce – Brenna (Sovicille) 307141; P.te Sterminaglia (Monticiano) 307124; La Madonna - S.Gusmè (Castelnuovo B.ga) 297322; Casette Burchianti (Chiusdino) 307414; Luriano (Chiusdino) 307423; Loc. Motrano (Sovicille) 296422; La Sensanese (Castel S. Gimignano) 286333; Casato Francolini (Monticiano) 307131; Pod. La Gonna (Monticiano) 307131; Travale (Radicondoli) 296332; Imposto (Monticiano) 307211; Fosini (Radicondoli) 306113.

Amanita phalloides (Fr.) Link

Chorology: August-December

Altitudinal range: 0-1200 m

Habitat: woody areas dominated by *Abies alba* Miller and *Picea excelsa* (Lam.) Link; mixed wood of *Castanea sativa* Miller and *Quercus cerris* L.; mixed wood of *Quercus ilex* and *Pinus* spp.; mixed wood of *Quercus* ilex L. and *Q. suber* L.; mixed wood of *Quercus cerris* L., *Q. pubescens* Willd. and *Q. ilex* L.; woody areas dominated by *Q. ilex* L.

Bagni di Petriolo (Monticiano) 307211; Campo dei Renai (Siena) 296124; Carpineto (Sovicille) 296214; Castelvecchio (S. Gimignano) 285221; Cerbaie (Monticiano) 307214; Iesa - Poggiolungo (Monticiano) 307214; Il Casalino - Le Badesse (Monteriggioni) 296114; Il Poggio - Vagliagli (Castelnuovo B.ga) 287333; Il Santo (Monticiano) 307211; Lecceta di S.Francesco (Piancastagnaio) 320221; Libbiano (S. Gimignano) 285212; Loc. Motrano (Sovicille) 296422; M.te Morio - Fungaia (Monteriggioni) 296131; Piancastagnaio 321334; Pigelleto - M.te Amiata (Piancastagnaio) 320222; Pod. La Gonna (Monticiano) 307131; Poggio ai Legni (Sovicille) 296133; Poggio Lungo (Monticiano) 307214; Pozzaroni (Abbadia S. Salvatore) 320212; S.Colomba (Monteriggioni) 296131; Stitelli (Rapolano) 297122; Travale (Radicondoli) 296332; V.la Carpineto-S.Rocco a Pilli (Sovicille) 296214; Vagliagli (Castelnuovo B.ga) 287333.

***Auriscalpium vulgare* Gray**

Chorology: April, November-December
Altitudinal range: 300-900 m
Habitat: woody areas dominated by *Abies alba* Miller and *Picea excelsa* (Lam.) Link, woody areas dominated by *Quercus ilex* L.

Loc. C. Ripi (Casole d'Elsa) 296341; Leccetella (Murlo) 307121; Pigelleto - M.te Amiata (Piancastagnaio) 320222.

***Boletus aereus* Bull.**

Chorology: June, September-November
Altitudinal range: 300-900 m
Habitat: mixed wood of *Quercus cerris* L. and *Castanea sativa* Miller; woody areas dominated by *Castanea sativa* Miller; woody areas dominated by *Q. ilex* L.; mixed wood of *Q. ilex* L. and *Pinus pinea* L.; woody areas dominated by *Quercus cerris* L., *Q. pubescens* Willd. and *Q. ilex* L.; woody areas dominated by *Quercus cerris* L., *Q. pubescens* Willd. and *Castanea sativa* Miller.

Casato Francolini (Monticiano) 307131; Castello di Tocchi (Monticiano) 307124; Fosini (Radicondoli) 306113; Imposto (Monticiano) 307211; La Madonna - S.Gusmè (Castelnuovo B.ga) 297322; La Sensanese (Castel S.Gimignano) 286333; Le Campore (S. Gimignano) 285221; Libbiano (S. Gimignano) 285212; M.te Morio – Fungaia (Monteriggioni) 296131; Monticiano 307134; Piancastagnaio 321334; Pod. La Caggia (Sovicille) 296133; Pod. La Gonna (Monticiano) 307131; Romitorio (S. Gimignano) 285212; S.Colomba (Monteriggioni) 296131; Sartiano (Sovicille) 296133; Terme di Galleraie (Radicondoli) 307444; between Serre di Rapolano and San Gemignanello (Rapolano) 29721/2; Travale (Radicondoli) 296332.

***Boletus impolitus* Fr.**

Chorology: September
Altitudinal range: 300-600 m
Habitat: woody areas dominated by *Quercus ilex* L.

Leccetella (Murlo) 307121

***Boletus satanas* Lenz**

Chorology: September-October
Altitudinal range: 0-600 m
Habitat: mixed wood of *Quercus cerris* L., *Q. pubescens* Willd. and *Q. ilex* L.

Il Casalino - Le Badesse (Monteriggioni) 296114; M.te Morio - Fungaia (Monteriggioni) 296131; Fosso Bucoli (Monticiano) 307214; Bosco di Lecceto (Siena) 296123; Castellina in Chianti 286211.

***Chroogomphus fulmineus* (Heim) Courtecuisse**

Chorology: September

Altitudinal range: 0-300 m
Habitat: woody areas dominated by *Pinus* spp.

Monteluco (Gaiole) 287331

Cortinarius aleuriosmus Maire

Chorology: October-December
Altitudinal range: 0-600 m
Habitat: mixed wood of *Pinus* spp. and *Quercus ilex* L.; mixed wood of *Quercus cerris* L., *Q. pubescens* Willd. and *Q. ilex* L.

M.te Morio - Fungaia (Monteriggioni) 296131; La Piramide - S.Leonardo al lago (Siena) 296123; Castello di Tocchi (Monticiano) 307124

Cortinarius bulliardii (Pers.) Fr.

Chorology: September-November
Altitudinal range: 0-600 m
Woody areas dominated by: *Quercus cerris* L., *Q. ilex* L., *Q. pubescens* Willd.

Bagni di Petriolo (Monticiano) 307211; Il Casalino - Le Badesse (Monteriggioni) 296114; La Piramide - S.Leonardo al lago (Siena) 296123; Montepescini (Murlo) 308433; Ponte a Macereto (Sovicille) 307124; Castel S. Gimignano (Colle Val d'Elsa) 286333; La Chiocciola (Monteriggioni) 296142; Loc. Motrano (Sovicille) 296422; S. Colomba (Monteriggioni) 296131; Travale (Radicondoli) 296332; Bosco di Lecceto (Siena) 296123.

Cortinarius croceocoeruleus (Pers.) Fr.

Chorology: January, October-December
Altitudinal range: 0-600 m
Habitat: mixed wood of *Pinus* spp. and *Quercus ilex* L.; woody areas dominated by *Q. ilex* L.; woody areas dominated by *Castanea sativa* Miller.

Castello di Tocchi (Monticiano) 307124; Il Gallinaio (Monteriggioni) 296141; Il Santo (Monticiano) 307211; La Madonna - S.Gusmè (Castelnuovo B.ga) 297322; Pod. Tolle - Scrofiano (Sinalunga) 298331; Selvaccia (Siena) 296123; Tegoia (Sovicille) 296244

Cortinarius ionochlorus Maire

Chorology: October
Altitudinal range: 0-600 m
Habitat: woody areas dominated by *Q. ilex* L.; mixed wood of *Quercus cerris* L., *Q. ilex* L. and *Q. pubescens* Willd.

Ponte a Macereto (Sovicille) 307124; Il Santo (Monticiano) 307211; San Giovannese (Chiusdino) 296233; Pod. Renellino (Torrita) 309431

Cortinarius orellanus (Fr.) Fr.

Chorology: October-December
Altitudinal range: 0-600 m
Habitat: mixed wood of *Quercus ilex* L. and *Pinus* spp.; mixed wood of *Quercus cerris* L., *Q. pubescens* Willd. and *Q. ilex* L.; mixed wood of *Q. cerris* L., *Q. pubescens* Willd. and *Castanea sativa* Miller.

Castello di Tocchi (Monticiano) 307124; Il Casalino - Le Badesse (Monteriggioni) 296114; Loc. Cornocchia (Radicondoli) 296324; Osteria delle Macchie (Monticiano) 307422; Pod. La Gonna (Monticiano) 307131

Cortinarius trivialis J. E. Lange

Chorology: September-December

Altitudinal range: 0-900 m

Habitat: woody areas dominated by *Cupressus sempervirens* L.; mixed wood of *Quercus cerris* L., *Q. pubescens* Willd. and *Castanea sativa* Miller; woody areas dominated by *Q. ilex* L.; mixed wood of *Q. ilex* L. and *Pinus* spp.; mixed wood of *Quercus cerris* L., *Q. pubescens* Willd. and *Q. ilex* L.; woody areas dominated by *Castanea sativa* Miller; woody areas dominated by *Abies alba* Miller and *Picea excelsa* (Lam.) Link; woody areas dominated by *Calluna vulgaris* (L.) Hull.; mixed wood of *Q. cerris* L. and *Castanea sativa* Miller

Bosco di Lecceto (Siena) 296123; Bosco di S. Agnese (Castellina in Chianti) 286241; Casa Volterrani (Castelnuovo B.ga) 297441; Casato Francolini (Monticiano) 307131; Castello di Tocchi (Monticiano) 307124; Centrale Geotermica Rancia (Radicondoli) 296332; Fosso Bucoli (Monticiano) 307214; Frontignano (Murlo) 307114; Il Casalino - Le Badesse (Monteriggioni) 296114; Il Santo (Monticiano) 307211; Imposto (Monticiano) 307211; La Chiocciola (Monteriggioni) 296142; La Madonna - S.Gusmè (Castelnuovo B.ga) 297322; La Piramide - S.Leonardo al lago (Siena) 296123; La Selva - Cornocchia (Radicondoli) 296314; Le Miniere di Murlo (Murlo) 308443; Libbiano (S. Gimignano) 285212; Loc. Cornocchia (Radicondoli) 296324; Loc. Motrano (Sovicille) 296422; M.te Morio - Fungaia (Monteriggioni) 296131; Montepescini (Murlo) 308433; Osteria delle Macchie (Monticiano) 307422; Piancastagnaio 321334; Pigelleto - M.te Amiata (Piancastagnaio) 320222; Pod. La Caggia (Sovicille) 296133; Pod. La Gonna (Monticiano) 307131; Pod. Renellino (Torrita) 309431; Pod. S. Giovannese (Chiusdino) 296233; Pod. Tolle - Scrofiano (Sinalunga) 298331; Poggio di Lali (Monticiano) 307134; Poggio la Guardia (Siena) 307131; Poggio Lungo (Monticiano) 307214; Ponte a Macereto (Sovicille) 307124; S.Colomba (Monteriggioni) 296131; Sartiano (Sovicille) 296133; Selvaccia (Siena) 296123; Strada del Ferratore (Siena) 296124; Travale (Radicondoli) 296332

Entoloma bloxami (Berk. & Broome) Sacc.

Chorology: October-November

Altitudinal range: 0-600 m

Habitat: woody areas dominated by *Cupressus sempervirens* L.; woody areas dominated by *Quercus ilex* L.

Bagni di Petriolo (Monticiano) 307211; Il Santo (Monticiano) 307211; Bosco di S. Agnese (Castellina in Chianti) 286241

Entoloma sinuatum (Bull.) P.Kumm.

Chorology: September-November

Altitudinal range: 0-600 m

Habitat: woody areas dominated by *Cupressus sempervirens* L.; mixed wood of *Quercus ilex* L., *Quercus* spp. and *Pinus* spp.; woody areas dominated by *Quercus* spp.; woody areas dominated by *Q. ilex* L.; mixed wood of *Q. cerris* L. and *Pinus pinea* L.; woody areas dominated by *Castanea sativa* Miller; woody areas dominated by *Abies alba* Miller and *Picea excelsa* (Lam.) Link; mixed wood of *Quercus cerris* L., *Q. pubescens* Willd. and *Q. ilex* L..

Bosco di Lecceto (Siena) 296123; Bosco di S. Agnese (Castellina in Chianti) 286241; Castelvecchio (S. Gimignano) 285221; Castiglion del Bosco (Montalcino) 308314; Centrale Geotermica Rancia (Radicondoli) 296332; Fioreta (Monteriggioni) 296142; Fosso Bucoli (Monticiano) 307214; La Sensanese (Castel S.Gimignano) 286333; Libbiano (S. Gimignano) 285212; Lutrelleta - Tonni (Sovicille) 296243; Montepescini (Murlo) 308433; Monticiano 307134; Piancastagnaio 321334; Ponte Sterminaglia (Monticiano) 307124; S. Angelo in Colle (Montalcino) 320411; S.Colomba (Monteriggioni) 296131; San Giovannese (Chiusdino) 296233; Tra Serre di Rap.e San Gemignanello (Rapolano) 29721/2; Travale (Radicondoli) 296332; Vagliagli (Castelnuovo B.ga) 287333.

Fistulina hepatica Bull.

Chorology: August-October
Altitudinal range: 0-1200 m
Habitat: mixed wood of *Quercus cerris* L., *Q. pubescens* Willd. and *Castanea sativa* Miller; woody areas dominated by *Castanea sativa* Miller; woody areas dominated by *Abies alba* Miller and *Picea excelsa* (Lam.) Link; mixed wood of *Q. ilex* L. and *Quercus* spp.

Casato Francolini (Monticiano) 307131; Celsa (Sovicille) 296133; La Madonna - S.Gusmè (Castelnuovo B.ga) 297322; Lutrelleta - Tonni (Sovicille) 296243; Pod. La Gonna (Monticiano) 307131; Pod. Tolle - Scrofiano (Sinalunga) 298331; Pozzaroni (Abbadia S. Salvatore) 320212; Sartiano (Sovicille) 296133; Scalvaia (Monticiano) 307311; Selvaccia (Siena) 296123; Tegoia (Sovicille) 296244; Travale (Radicondoli) 296332

Gyroporus castaneus (Bull.) Quél.

Chorology: September-December
Altitudinal range: 300-600 m
Habitat: mixed wood of *Quercus cerris* L., *Q. pubescens* Willd. and *Q. ilex* L.; woody areas dominated by *Abies alba* Miller and *Picea excelsa* (Lam.) Link.

Bosco di Lecceto (Siena) 296123; Fonte dell'Oro (Castiglion d'Orcia) 320122; M.te Morio - Fungaia (Monteriggioni) 296131; Marroni di Mucennino - Vagliagli (Castelnuovo B.ga) 286222; Orto Botanico di Siena 296122; Piancastagnaio 321334; Poggio Camporeale (Chiusdino) 321143; S.Colomba (Monteriggioni) 296131; Tra Serre di Rap.e San Gemignanello (Rapolano) 29721/2

Hebeloma sarcophyllum Peck

Chorology: October
Altitudinal range: 0-600 m
Habitat: mixed wood of *Quercus cerris* L., *Q. pubescens* Willd. and *Castanea sativa* Miller; mixed wood of *Q. ilex* L. and *Q. suber* L.

Pod. La Gonna (Monticiano) 307131; Cerbaie (Monticiano) 307214

Helvella crispa (Scop.) Fr.

Chorology: October-December
Altitudinal range: 0-600 m
Habitat: woody areas dominated by *Cupressus sempervirens* L.; woody areas dominated by *Quercus ilex* L.; woody areas dominated by *Castanea sativa* Miller; mixed wood of *Quercus cerris* L., *Q. pubescens* Willd. and *Q. ilex* L.; mixed wood of *Quercus* spp., *Q. ilex* L. and *Pinus* spp.

Montepescini (Murlo) 308433; Tegoia (Sovicille) 296244; Castel S. Gimignano (Colle Val d'Elsa) 286333; Bosco di S. Agnese (Castellina in Chianti) 286241; M.te Morio - Fungaia (Monteriggioni) 296131; Castelvecchio (S. Gimignano) 285221; Orto Botanico di Siena 296122.

Hirneola auricula-judae (Bull.) Berk.

Chorology: February, April, June, August-November
Altitudinal range: 0-600 m
Habitat: woody areas dominated by *Calluna vulgaris* (L.) Hull; woody areas dominated by *Quercus ilex* L.

Ancaiano (Sovicille) 296244; Bosconi (Trequanda) 298333; Castel S. Gimignano (Colle Val d'Elsa) 286333; La Croce - Brenna (Sovicille) 307141; Montepescini (Murlo) 308433; Orto Botanico di Siena 296122

Hydnellum concrescens (Pers.) Banker ss. str.

Chorology: March, September-December
Altitudinal range: 0-600 m
Habitat: woody areas dominated by *Cupressus sempervirens* L.; mixed wood of *Quercus cerris* L., *Q. pubescens* Willd. and *Castanea sativa* Miller; mixed wood of *Quercus* spp., *Q. ilex* L. and *Pinus* spp.; woody areas dominated by *Quercus ilex* L.; mixed wood of *Quercus cerris* L., *Q. pubescens* Willd. and *Quercus ilex* L.; woody areas dominated by *Castanea sativa* Miller; woody areas dominated by *Calluna vulgaris* (L.) Hull; woody areas dominated by *Pinus* spp.; *Quercus* spp.

Bosco di S. Agnese (Castellina in Chianti) 286241; Casato Francolini (Monticiano) 307131; Castellina in Chianti 286211; Castelvecchio (S. Gimignano) 285221; Fosso Bucoli (Monticiano) 307214; Il Casalino - Le Badesse (Monteriggioni) 296114; Imposto (Monticiano) 307211; La Madonna - S.Gusmè (Castelnuovo B.ga) 297322; La Piramide - S.Leonardo al lago (Siena) 296123; M.te Morio - Fungaia (Monteriggioni) 296131; Monte Quoio (Monticiano) 307133; Montepescini (Murlo) 308433; Osteria delle Macchie (Monticiano) 307422; Pod. La Gonna (Monticiano) 307131; Pod. Tolle - Scrofiano (Sinalunga) 298331; Poggio la Mignatta-Camigliano (Montalcino) 308332; Poggio La Torretta (Monticiano) 307142; Poggio Lungo (Monticiano) 307214; Ponte a Macereto (Sovicille) 307124; S. Angelo in Colle (Montalcino) 320411; S.Colomba (Monteriggioni) 296131; Tegoia (Sovicille) 296244; Travale (Radicondoli) 296332

Hygrophorus latitabundus Britzelm.

Chorology: December
Altitudinal range: 300-600 m
Habitat: coniferous wood

Loc. C. Ripi (Casole d'Elsa) 296341

Hygrophorus marzuolus (Fr.) Bres.

Chorology: February-March
Altitudinal range: 900-1200 m
Habitat: mixed wood

Fonte Iacobini (Piancastagnaio) 320222

Hygrophorus nemoreus (Pers.) Fr.

Chorology: October-December
Altitudinal range: 0-600 m
Habitat: mixed wood of *Quercus cerris* L., *Q. pubescens* Willd. and *Castanea sativa* Miller; woody areas dominated by *Q. ilex* L.; mixed wood of *Quercus cerris* L., *Q. pubescens* Willd. and *Q. ilex* L.; mixed wood of *Q. cerris* L. and *Pinus pinea* L.; mixed wood of *Q. cerris* L. and *Castanea sativa* Miller

Casa Volterrani (Castelnuovo B.ga) 297441; Casato Francolini (Monticiano) 307131; Castello di Tocchi (Monticiano) 307124; Centrale Geotermica Rancia (Radicondoli) 296332; Fosso Bucoli (Monticiano) 307214; Il Santo (Monticiano) 307211; La Piramide - S.Leonardo al lago (Siena) 296123; La Sensanese (Castel S. Gimignano) 286333; M.te Morio - Fungaia (Monteriggioni) 296131; Osteria delle Macchie (Monticiano) 307422; Pod. La Gonna (Monticiano) 307131; Poggio la Guardia (Siena) 307131; Ponte a Macereto (Sovicille) 307124; Quattrostrade (Castellina in Chianti) 286223; S. Rocco a Pilli (Sovicille) 296213; Travale (Radicondoli) 296332

Hygrophorus penarius Fr.

Chorology: September-December
Altitudinal range: 0-600 m

Habitat: woody areas dominated by *Quercus ilex* L.; mixed wood of *Q. cerris* L., *Q. pubescens* Willd and *Castanea sativa* Miller; mixed wood of *Q. ilex* L. and *Pinus* spp.; mixed wood of *Q. ilex* L., *Quercus* spp. and *Pinus* spp.; mixed wood of *Q. cerris* L., *Q. pubescens* Willd and *Q. ilex* L.; woody areas dominated by *Q. cerris* L.; mixed wood of *Q. cerris* L. and *Pinus pinea* L.

Belriguardo (Siena) 296124; Bosco di Lecceto (Siena) 296123; Bracciano (Monteriggioni) 296142; Casa Volterrani (Castelnuovo B.ga) 297441; Casato Francolini (Monticiano) 307131; Castello di Tocchi (Monticiano) 307124; Castelvecchio (S. Gimignano) 285221; Centrale Geotermica Rancia (Radicondoli) 296332; Fioreta (Monteriggioni) 296142; Frontignano (Murlo) 307114; Il Casalino - Le Badesse (Monteriggioni) 296114; Il Santo (Monticiano) 307211; Imposto (Monticiano) 307211; La Chiocciola (Monteriggioni) 296142; La Foce (Chianciano) 309324; La Piramide - S.Leonardo al lago (Siena) 296123; La Sensanese (Castel S. Gimignano) 286333; Le Campore (S. Gimignano) 285221; Libbiano (S. Gimignano) 285212; Loc. Motrano (Sovicille) 296422; M.te Morio - Fungaia (Monteriggioni) 296131; Marocco (Rapolano) 297124; Montefalconi (Poggibonsi) 286314; Montepescini (Murlo) 308433; Pod. Renellino (Torrita) 309431; San Giovannese (Chiusdino) 296233; Stitelli (Rapolano) 297122; Strove (Monteriggioni) 296144; Terme di Galleraie (Radicondoli) 307444; Torri (Sovicille) 296231; Travale (Radicondoli) 296332

***Hygrophorus persoonii* Arnolds**

Chorology: September-December
Altitudinal range: 0-600 m
Habitat: woody areas dominated by *Quercus ilex* L.; mixed wood of *Q. cerris* L., *Q. pubescens* Willd and *Castanea sativa* Miller; mixed wood of *Q. ilex* L. and *Pinus* spp.; mixed wood of *Q. cerris* L., *Q. pubescens* Willd and *Q. ilex* L.; woody areas dominated by *Q. cerris* L.; mixed wood of *Q. cerris* L. and *Pinus pinea* L.; mixed wood of *Pinus pinaster* Aiton and *Quercus* spp.; woody areas dominated by *Castanea sativa* Miller

Bosco di Lecceto (Siena) 296123; Bosconi (Trequanda) 298333; Bracciano (Monteriggioni) 296142; Casato Francolini (Monticiano) 307131; Castel S. Gimignano (Colle Val d'Elsa) 286333; Castello di Tocchi (Monticiano) 307124; Centrale Geotermica Rancia (Radicondoli) 296332; Fosso Bucoli (Monticiano) 307214; Il Casalino - Le Badesse (Monteriggioni) 296114; Imposto (Monticiano) 307211; La Chiocciola (Monteriggioni) 296142; La Foce (Chianciano) 309324; La Piramide - S.Leonardo al lago (Siena) 296123; La Sensanese (Castel S. Gimignano) 286333; Libbiano (S. Gimignano) 285212; M.te Morio - Fungaia (Monteriggioni) 296131; Montepescini (Murlo) 308433; Osteria delle Macchie (Monticiano) 307422; Pod. La Gonna (Monticiano) 307131; Pod. Renellino (Torrita) 309431; Poggio Lungo (Monticiano) 307214; Radicondoli 296342; S.Colomba (Monteriggioni) 296131; Selvaccia (Siena) 296123; Travale (Radicondoli) 296332

***Hygrophorus roseodiscoideus* Bon & Chevassut**

Chorology: January, October-December
Altitudinal range: 0-600 m
Habitat: woody areas dominated by *Cupressus sempervirens* L.; woody areas dominated by *Quercus ilex* L.; mixed wood of *Q. ilex* L. and *Pinus* spp.; mixed wood of *Q. ilex* L. *Quercus* spp. and *Pinus* spp.; mixed wood of *Q. cerris* L., *Q. pubescens* Willd. and *Q. ilex* L.; mixed wood of *Q. ilex* L. and *Q, cerris* L.

Bosco di S. Agnese (Castellina in Chianti) 286241; Bracciano (Monteriggioni) 296142; Castello di Tocchi (Monticiano) 307124; Castelvecchio (S. Gimignano) 285221; Il Casalino - Le Badesse (Monteriggioni) 296114; Il Gallinaio (Monteriggioni) 296141; Il Santo (Monticiano) 307211; La Piramide - S.Leonardo al lago (Siena) 296123; Loc. Casanova (Casole d'Elsa) 296341; Loc. Cornocchia (Radicondoli) 296324; M.te Morio - Fungaia (Monteriggioni) 296131; Montepescini (Murlo) 308433; Pod. Renellino (Torrita) 309431; Ponte a Macereto (Sovicille) 307124; S.Colomba (Monteriggioni) 296131; San Giovannese (Chiusdino); Villa del Cetinale - Ancaiano (Sovicille) 296244

***Hygrophorus russula* (Fr.) Quél.**

Chorology: January, September-December
Altitudinal range: 0-900 m

Habitat: woody areas dominated by *Cupressus sempervirens* L.; woody areas dominated by *Quercus ilex* L.; mixed wood of *Q. cerris* L., *Q. pubescens* Willd. and *Castanea sativa* Miller; woody areas dominated by *Pinus* spp.; mixed wood of *Q. ilex* and *Pinus* spp.; mixed wood of *Quercus* spp., *Q. ilex* L. and *Pinus* spp.; mixed wood of *Q. ilex* L. and *Q. suber* L.; woody areas dominated by *Castanea sativa* Miller; woody areas dominated by *Pinus* spp.; mixed wood of *Q. cerris* L., *Q. pubescens* Willd. and *Q. ilex* L.; mixed wood of *Q. cerris* L. and *Q. pubescens* Willd.; mixed wood of *Q. cerris* L. and *Pinus pinea* L.

Ancaiano (Sovicille) 296244; Bagni di Petriolo (Monticiano) 307211; Belriguardo (Siena) 296124; Bosco di Lecceto (Siena) 296123; Bosco di S. Agnese (Castellina in Chianti) 286241; Bracciano (Monteriggioni) 296142; Casato Francolini (Monticiano) 307131; Castel S. Gimignano (Colle Val d'Elsa) 286333; Castellina in Chianti 286211; Castello di Tocchi (Monticiano) 307124; Castelvecchio (S. Gimignano) 285221; Cerbaie (Monticiano) 307214; Fioreta (Monteriggioni) 296142; Fosso Bucoli (Monticiano) 307214; Iesa - Poggiolungo (Monticiano) 307214; Il Casalino - Le Badesse (Monteriggioni) 296114; Il Gallinaio (Monteriggioni) 296141; Il Santo (Monticiano) 307211; Imposto (Monticiano) 307211; La Chiocciola (Monteriggioni) 296142; La Piramide - S.Leonardo al lago (Siena) 296123; La Selva - Cornocchia (Radicondoli) 296314; La Sensanese (Castel S. Gimignano) 286333; Le Campore (S. Gimignano) 285221; Le Miniere di Murlo (Murlo) 308443; Lecciatella (Casciano di Murlo) 307112; Libbiano (S. Gimignano) 285212; Loc. Cornocchia (Radicondoli) 296324; Loc. Motrano (Sovicille) 296422; M.te Morio - Fungaia (Monteriggioni) 296131; Montecucco (Castiglion d'Orcia) 320143; Montefalconi (Poggibonsi) 286314; Montepescini (Murlo) 308433; Monticiano 307134; Pod. La Gonna (Monticiano) 307131; Pod. Renellino (Torrita) 309431; Poggio ai Legni (Sovicille) 296133; Ponte a Macereto (Sovicille) 307124; Pulcianese (Monteroni) 296222; San Giovannese (Chiusdino) 296233; Strove (Monteriggioni) 296144; Travale (Radicondoli) 296332

***Inocybe asterospora* Quél.**

Chorology: June, October-December
Altitudinal range: 0-1200 m
Habitat: mixed wood of *Quercus cerris* L., *Q. pubescens* Willd. and *Castanea sativa* Miller; woody areas dominated by *Quercus ilex* L.; woody areas dominated by *Abies alba* Miller, *Picea excelsa* (Lam.) Link

Casato Francolini (Monticiano) 307131; Castello di Tocchi (Monticiano) 307124; Montarioso - Pod. La Cipriana (Abbadia S. Salvatore) 320212; Orto Botanico di Siena 296122; Pod. La Gonna (Monticiano) 307131; Poggio Lungo (Monticiano) 307214; S.Colomba (Monteriggioni) 296131; Travale (Radicondoli) 296332

***Inocybe bongardii* (Weinm.) Quél.**

Chorology: October-December
Altitudinal range: 0-600 m
Habitat: woody areas dominated by *Quercus ilex* L.; mixed wood of *Q. cerris* L., *Q pubescens* L. and *Q. ilex* L.

Bagni di Petriolo (Monticiano) 307211; Il Casalino - Le Badesse (Monteriggioni) 296114; Il Santo (Monticiano) 307211; La Piramide - S.Leonardo al lago (Siena) 296123; Loc. Motrano (Sovicille) 296422; M.te Morio - Fungaia (Monteriggioni) 296131; Ponte a Macereto (Sovicille) 307124; S.Colomba (Monteriggioni) 296131

***Lactarius atlanticus* Bon**

Chorology: January, October-November
Altitudinal range: 0-600 m
Habitat: woody areas dominated by *Cupressus sempervirens* L.; mixed wood of *Quercus ilex* L. and *Pinus* spp.; woody areas dominated by *Q. ilex* L.; mixed wood of *Q. ilex* L. and *Q. suber* L.; mixed wood of *Q. cerris* L., *Q pubescens* L. and *Castanea sativa* Miller; woody areas dominated by *Castanea sativa* Miller

Bagni di Petriolo (Monticiano) 307211; Bosco di S. Agnese (Castellina in Chianti) 286241; Castello di Tocchi (Monticiano) 307124; Cerbaie (Monticiano) 307214; La Chiocciola (Monteriggioni) 296142; Libbiano (S. Gimignano) 285212; Montepescini (Murlo) 308433; Osteria delle Macchie (Monticiano) 307422; Pod. La Gonna (Monticiano) 307131; Pod. Renellino (Torrita) 309431; Pod. Tolle - Scrofiano (Sinalunga) 298331; Travale (Radicondoli) 296332

***Lactarius chrysorrheus* Fr.**

Chorology: January, July, September-December
Altitudinal range: 0-900 m
Habitat: woody areas dominated by *Quercus ilex* L.; mixed wood of *Q. cerris* L., *Q pubescens* Willd. and *Castanea sativa* Miller; mixed wood of *Q. ilex* L., *Quercus* spp. and *Pinus* spp.; mixed wood of *Q. ilex* L. and *Q. suber* L.; woody areas dominated by *Castanea sativa* Miller; mixed wood of *Q. cerris* L., *Q pubescens* Willd. and *Q. ilex* L.; mixed wood of *Q. cerris* L. and *Pinus pinea* L.; woody areas dominated by *Calluna vulgaris* (L.) Hull; woody areas dominated by *Abies alba* Miller and *Picea excelsa* (Lam.) Link;

Bagni di Petriolo (Monticiano) 307211; Bosco di Lecceto (Siena) 296123; Bracciano (Monteriggioni) 296142; Casato Francolini (Monticiano) 307131; Castel S. Gimignano (Colle Val d'Elsa) 286333; Castellina in Chianti 286211; Castello di Tocchi (Monticiano) 307124; Castelvecchio (S. Gimignano) 285221; Centrale Geotermica Rancia (Radicondoli) 296332; Cerbaie (Monticiano) 307214; Iesa - Poggiolungo (Monticiano); Il Casalino - Le Badesse (Monteriggioni) 296114; Il Santo (Monticiano) 307211; Imposto (Monticiano) 307211; La Chiocciola (Monteriggioni) 296142; La Piramide - S.Leonardo al lago (Siena) 296123; La Sensanese (Castel S. Gimignano) 286333; Le Miniere di Murlo (Murlo) 308443; Leccetella (Murlo) 307121; Lecciatella (Casciano di Murlo) 307112; Loc. Casanova (Casole d'Elsa) 296341; Loc. Motrano (Sovicille) 296422; Lutrelleta - Tonni (Sovicille) 296243; M.te Morio - Fungaia (Monteriggioni) 296131; Monte Quoio (Monticiano) 307133; Montepescini (Murlo) 308433; Osteria delle Macchie (Monticiano) 307422; Piancastagnaio 321334; Pigelleto - M.te Amiata (Piancastagnaio); Pod. Il Canile (Monticiano) 307133; Pod. La Gonna (Monticiano) 307131; Pod. Renellino (Torrita) 309431; Pod. Tolle - Scrofiano (Sinalunga) 298331; Poggio ai Legni (Sovicille) 296133; Poggio di Lali (Monticiano) 307134; Poggio La Torretta (Monticiano) 307142; Poggio Lungo (Monticiano) 307214; Poggio Scalari (Monticiano) 307134; Ponte a Macereto (Sovicille) 307124; S.Colomba (Monteriggioni) 296131; San Giovannese (Chiusdino); Sartiano (Sovicille) 296133; Selvaccia (Siena) 296123; Stitelli (Rapolano) 297122; Strada del Ferratore (Siena) 296124; Strove (Monteriggioni) 296144; Tegoia (Sovicille) 296244; Travale (Radicondoli) 296332.

***Lactarius ilicis* Sarnari**

Chorology: November
Altitudinal range: 0-600 m
Habitat: woody areas dominated by *Quercus ilex* L.; mixed wood of *Q. cerris* L., *Q pubescens* Willd. and *Q. ilex* L.; mixed wood of *Q. ilex* L., *Quercus* spp. and *Pinus* spp.

Castello di Tocchi (Monticiano) 307124; M.te Morio - Fungaia (Monteriggioni) 296131; Castelvecchio (S. Gimignano) 285221

***Lactarius mediterraneensis* Llistosella & Bellú**

Chorology: October-November
Altitudinal range: 0-600 m
Habitat: woody areas dominated by *Cupressus sempervirens* L.; woody areas dominated by *Quercus ilex* L.; mixed wood of *Quercus cerris* L., *Q. pubescens* Willd. and *Q. ilex* L.

Bosco di S. Agnese (Castellina in Chianti) 286241; Castellina in Chianti 286211; Il Santo (Monticiano) 307211; M.te Morio - Fungaia (Monteriggioni) 296131

***Leccinum lepidum* (P. Bouchet ex Essette) Quadr.**

Chorology: January, April, October-December
Altitudinal range: 0-900 m
Habitat: woody areas dominated by *Cupressus sempervirens* L.; woody areas dominated by *Quercus ilex* L.; mixed wood of *Q. ilex* L. and *Pinus* spp.; mixed wood of *Q. ilex* L., *Quercus* spp. and *Pinus* spp.; woody areas dominated by *Castanea sativa* Miller;

Ancaiano (Sovicille) 296244; Bagni di Petriolo (Monticiano) 307211; Bosco di S. Agnese (Castellina in Chianti) 286241; Bracciano (Monteriggioni) 296142; Castel S. Gimignano (Colle Val d'Elsa) 286333; Castellina in Chianti 286211; Castello di Tocchi (Monticiano) 307124; Castelvecchio (S. Gimignano) 285221; Centrale Geotermica Rancia (Radicondoli) 296332; Fioreta (Monteriggioni) 296142; Fosso Bucoli (Monticiano) 307214; Il Gallinaio (Monteriggioni) 296141; Imposto (Monticiano) 307211; La Chiocciola (Monteriggioni) 296142; Le Miniere di Murlo (Murlo) 308443; Leccetella (Murlo) 307121; Lecciatella (Casciano di Murlo) 307112; Libbiano (S. Gimignano) 285212; Loc. Motrano (Sovicille) 296422; Montecucco (Castiglion d'Orcia) 320143; Montepescini (Murlo) 308433; Poggio ai Legni (Sovicille) 296133; Ponte a Macereto (Sovicille) 307124; Quarciglione (Monticiano) 307241; San Giovannese (Chiusdino); San Laurentino (Castelnuovo B.ga) 297413; Strada del Ferratore (Siena) 296124.

***Marasmius alliaceus* (Jacq.) Fr.**

Chorology: October-November
Altitudinal range: 0-600
Habitat: woody areas dominated by *Quercus ilex* L.; mixed wood of *Q. cerris* L., *Q pubescens* Willd. and *Q ilex* L.

Ponte a Macereto (Sovicille) 307124; S.Colomba (Monteriggioni) 296131

***Mycena pelianthina* (Fr.) Quél.**

Chorology: June, September-December
Altitudinal range: 0-1200 m
Habitat: mixed wood of *Quercus* spp., *Q. ilex* L. and *Pinus* spp.; mixed wood of *Q. cerris* L., *Q. pubescens* Willd. and *Q. ilex* L.; woody areas dominated by *Q. ilex* L.; woody areas dominated by *Abies alba* Miller and *Picea excelsa* (Lam.) Link; mixed wood of *Q. cerris* L., *Q. pubescens* Willd. and *Castanea sativa* Miller; woody areas dominated by *Castanea sativa* Miller

Castelvecchio (S. Gimignano) 285221; Centrale Geotermica Rancia (Radicondoli) 296332; Il Casalino - Le Badesse (Monteriggioni) 296114; La Chiocciola (Monteriggioni) 296142; La Piramide - S.Leonardo al lago (Siena) 296123; M.te Morio - Fungaia (Monteriggioni) 296131; Montarioso - Pod. La Cipriana (Abbadia S. Salvatore) 320212; Osteria delle Macchie (Monticiano) 307422; Pigelleto - M.te Amiata (Piancastagnaio); Pod. Cipriana (Abbadia S. Salvatore) 320212; Pod. La Gonna (Monticiano) 307131; Pod. Tolle - Scrofiano (Sinalunga) 298331; Poggio la Guardia (Siena) 307131; Ponte a Macereto (Sovicille) 307124; Pozzaroni (Abbadia S. Salvatore) 320212; S.Colomba (Monteriggioni) 296131; San Giovannese (Chiusdino); Travale (Radicondoli) 296332

***Omphalotus olearius* (DC.) Fayod**

Chorology: September-November
Altitudinal range: 0-600 m
Habitat: mixed wood of *Quercus cerris* L., *Q. pubescens* Willd. and *Castanea sativa* Miller; woody areas dominated by *Castanea sativa* Miller; mixed wood of *Quercus cerris* L. and *Q. pubescens* Willd.; mixed wood of *Quercus cerris* L., *Q. pubescens* Willd. and *Q. ilex* L.

Casato Francolini (Monticiano) 307131; Centrale Geotermica Rancia (Radicondoli) 296332; Frontignano (Murlo) 307114; La Madonna - S.Gusmè (Castelnuovo B.ga) 297322; La Selva - Cornocchia (Radicondoli) 296314; Le Campore (S. Gimignano) 285221; Lutrelleta - Tonni (Sovicille) 296243; Montechiaro - Pieve al Bozzone (Siena) 297431; Orto Botanico di Siena 296122; Pod. La Gonna (Monticiano) 307131; S.Colomba (Monteriggioni) 296131; San Giovannese (Chiusdino), Selvarella (Siena) 296123; between Serre di Rapolano and San Gemignanello (Rapolano) 29721/2; Vignano (Siena) 297434.

***Phallus impudicus* L.**
Chorology: October, December
Altitudinal range: 300-600 m
Habitat: woody areas dominated by *Quercus cerris* L. and *Q pubescens* Willd.

Loc. Il Turamino (Sovicille); Orto Botanico di Siena 296122

***Phylloporus pelletieri* (Lév.) Quél.**

Chorology: September
Altitudinal range: 900-1200 m
Habitat: mixed wood

Fonte dell'Oro (Castiglion d'Orcia)

***Pisolithus arhizus* (Scop.) Rauschert**

Chorology: November
Altitudinal range: 300-600 m
Habitat: woody areas dominated by *Cupressus sempervirens* L.

Bosco di S. Agnese (Castellina in Chianti) 286241

***Pseudohydnum gelatinosum* (Scop.) P.Karst.**

Chorology: February, July, September-December
Altitudinal range: 600-900 m
Habitat: woody areas dominated by *Abies alba* Miller and *Picea excelsa* (Lam.) Link

Pigelleto - M.te Amiata (Piancastagnaio)

***Rozites caperatus* (Pers.) P. Karst.**

Chorology: September-November
Altitudinal range: 0-600 m
Habitat: mixed wood of *Quercus* spp., *Q. ilex* L. and *Pinus* spp.; mixed wood of *Q. cerris* L., *Q pubescens* Willd. and *Castanea sativa* Miller; woody areas dominated by *Castanea sativa* Miller

Castelvecchio (S. Gimignano) 285221; Le Campore (S. Gimignano) 285221; Osteria delle Macchie (Monticiano) 307422; Pod. La Gonna (Monticiano) 307131; Selvaccia (Siena) 296123

***Russula acrifolia* Romagn.**

Chorology: September-November
Altitudinal range: 0-600 m
Habitat: mixed wood of *Quercus* spp., *Q. ilex* L. and *Pinus* spp.; woody areas dominated by *Q. ilex* L. and *Q. suber* L.; woody areas dominated by *Q. ilex* L.; mixed wood of *Quercus cerris* L., *Q. pubescens* Willd. and *Q. ilex* L.; mixed wood of *Quercus cerris* L., *Q. pubescens* Willd. and *Castanea sativa* Miller

Bagni di Petriolo (Monticiano) 307211; Castelvecchio (S. Gimignano) 285221; Cerbaie (Monticiano) 307214; Loc. Motrano (Sovicille) 296422; M.te Morio - Fungaia (Monteriggioni) 296131; Montepescini (Murlo) 308433; Piancastagnaio 321334; Pod. La Gonna (Monticiano) 307131; Tra Serre di Rap.e San Gemignanello (Rapolano) 29721/2

***Russula rubroalba* (Singer) Romagn.**

Chorology: October, November
Altitudinal range: 0-600 m
Habitat: mixed wood of *Quercus cerris* L., *Q. pubescens* Willd. and *Castanea sativa* Miller; mixed wood of *Quercus cerris* L., *Q. pubescens* Willd. and *Q. ilex* L.

M.te Morio - Fungaia (Monteriggioni) 296131; Piancastagnaio 321334; Pod. La Gonna (Monticiano) 307131; S.Colomba (Monteriggioni) 296131

Russula seperina **Dupain**

Chorology: October
Altitudinal range: 300-600 m
Habitat: mixed wood of *Quercus ilex* L. and *Q. suber* L.

Cerbaie (Monticiano) 307214

Russula virescens **(Schaeff.) Fr.**

Chorology: June, September-November
Altitudinal range: 0-900 m
Habitat: woody areas dominated by *Quercus ilex* L.; : woody areas dominated by *Q. cerris* L.; woody areas dominated by *Castanea sativa* Miller;

Il Santo (Monticiano) 307211; La Foce (Chianciano) 309324; Loc. Motrano (Sovicille) 296422; Poggio ai Legni (Sovicille) 296133; San Giovannese (Chiusdino); Selvaccia (Siena) 296123; Tra Serre di Rap.e San Gemignanello (Rapolano) 29721/2; Travale (Radicondoli) 296332

Suillus bovinus **(L.) Roussel**

Chorology: May, September-December
Altitudinal range: 0-1200 m
Habitat: woody areas dominated by *Castanea sativa* Miller; woody areas dominated by *Calluna vulgaris* (L.) Hull; woody areas dominated by *Pinus* spp.; woody areas dominated by *Abies alba* Miller and *Picea excelsa* (Lam.) Link

Castellina in Chianti 286211; Fonterutoli (Castellina in Chianti) 286221; Iesa - Poggiolungo (Monticiano); La Croce - Brenna (Sovicille) 307141; Monte Quoio (Monticiano) 307133; Pineta di Iesa (Monticiano) 307123 307214; Pod. Il Canile (Monticiano) 307133; Poggio di Lali (Monticiano) 307134; Poggio La Torretta (Monticiano) 307142; Poggio Lungo (Monticiano) 307214; Poggio Scalari (Monticiano) 307134; Pozzaroni (Abbadia S. Salvatore) 320212

Tricholoma acerbum **(Bull.) Quél.**

Chorology: October-December
Altitudinal range: 0-600 m
Habitat: mixed wood of *Quercus cerris* L., *Q. pubescens* Willd. and *Castanea sativa* Miller; woody areas dominated by *Q. ilex* L.; mixed wood of *Quercus* spp., *Q. ilex* L. and *Pinus* spp.; woody areas dominated by *Castanea sativa* Miller; mixed wood of., *Q. cerris* L. and *Pinus pinea* L; mixed wood of *Q. cerris* L., *Q. pubescens* Willd. and *Q. ilex* L.; woody areas dominated by *Pinus* spp.

Bagni di Petriolo (Monticiano) 307211; Casato Francolini (Monticiano) 307131; Castello di Tocchi (Monticiano) 307124; Castelvecchio (S. Gimignano) 285221; Castiglione d'Orcia; Fioreta (Monteriggioni) 296142; Fosso Bucoli (Monticiano) 307214; Imposto (Monticiano) 307211; La Chiocciola (Monteriggioni) 296142; La Madonna - S.Gusmè (Castelnuovo B.ga) 297322; La Sensanese (Castel S.Gimignano); Leccetella (Murlo) 307121; Lutrelleta - Tonni (Sovicille) 296243
M.te Morio - Fungaia (Monteriggioni) 296131; Monte Maggio (Monteriggioni) 296134; Montepescini (Murlo) 308433; Pineta di Iesa (Monticiano) 307123 307214; Pod. La Gonna (Monticiano) 307131; Pod. Renellino (Torrita) 309431; Poggio Lungo (Monticiano) 307214; Ponte a Macereto (Sovicille) 307124; S. Angelo in Colle (Montalcino) 320411; San Giovannese (Chiusdino); Serre di Rapolano (Rapolano) 297213; Tegoia (Sovicille) 296244

Tricholoma aurantium **(Schaeff.) Ricken**

Chorology: September-November
Altitudinal range: 0-600 m

Habitat: woody areas dominated by *Cupressus sempervirens* L.; woody areas dominated by *Quercus ilex* L.; mixed wood of *Q. cerris* L., *Q. pubescens* Willd. and *Q. ilex* L.; woody areas dominated by *Calluna vulgaris* (L.) Hull;

Ancaiano (Sovicille) 296244; Bosco di S. Agnese (Castellina in Chianti) 286241; Castel S. Gimignano (Colle Val d'Elsa) 286333; Castello di Tocchi (Monticiano) 307124; La Piramide - S.Leonardo al lago (Siena) 296123; M.te Morio - Fungaia (Monteriggioni) 296131; Monte Quoio (Monticiano) 307133; Montepescini (Murlo) 308433; Pod. Il Canile (Monticiano) 307133; Pod. Renellino (Torrita) 309431; Strove (Monteriggioni) 296144

***Tricholoma bresadolanum* Clemençon**

Chorology: October, November
Altitudinal range: 0-900 m
Habitat: woody areas dominated by *Quercus ilex* L.; mixed wood of *Quercus* spp., *Q. ilex* L. and *Pinus* spp.; woody areas dominated by *Castanea sativa* Miller; mixed wood of *Q. cerris* L. and *Pinus pinea* L.; mixed wood of *Abies alba* Miller, *Acer* spp. *Fagus sylvatica* L. and *Picea excelsa* (Lam.) Link; mixed wood of *Q. cerris* L., *Q. pubescens* Willd. and *Q. ilex* L.

Castello di Tocchi (Monticiano) 307124; Castelvecchio (S. Gimignano) 285221; Castiglione d'Orcia; La Madonna - S.Gusmè (Castelnuovo B.ga) 297322; La Sensanese (Castel S.Gimignano); Libbiano (S. Gimignano) 285212; M.te Morio - Fungaia (Monteriggioni) 296131; S.Colomba (Monteriggioni) 296131; Tra Serre di Rap.e San Gemignanello (Rapolano) 29721/2; Vagliagli (Castelnuovo B.ga) 287333; Vivo d'Orcia (Castiglion d'Orcia) 320121

***Tricholoma equestre* (L.) P.Kumm.**

Chorology: September-December
Altitudinal range: 0-600 m
Habitat: woody areas dominated by *Cupressus sempervirens* L.; mixed wood of *Quercus cerris* L., *Q. pubescens* Willd. and *Castanea sativa* Miller; woody areas dominated by *Q. ilex* L.; mixed wood of *Q. ilex* L. and *Pinus* spp.; mixed wood of *Quercus cerris* L., *Q. pubescens* Willd. and *Q. ilex* L.; woody areas dominated by *Calluna vulgaris* (L.) Hull; woody areas dominated by *Pinus* spp.

Bosco di S. Agnese (Castellina in Chianti) 286241; Casato Francolini (Monticiano) 307131; Castellina in Chianti 286211; Castello di Tocchi (Monticiano) 307124; La Sensanese (Castel S.Gimignano); M.te Morio - Fungaia (Monteriggioni) 296131; Monte Quoio (Monticiano) 307133; Montepescini (Murlo) 308433; Monticiano 307134; Pineta di Iesa (Monticiano) 307123 307214; Poggio di Lali (Monticiano) 307134

***Tricholoma squarrulosum* Bres.**

Chorology: January, October-December
Altitudinal range: 0-900 m
Habitat: woody areas dominated by *Cupressus sempervirens* L.; woody areas dominated by *Quercus ilex* L.; mixed wood of *Q. cerris* L., *Q. pubescens* Willd. and *Q. ilex* L.; mixed wood of *Q. cerris* L. and *Pinus pinea* L.; mixed wood of *Q. cerris* L., *Q. pubescens* Willd. and *Castanea sativa* Miller; woody areas dominated by *Abies alba* Miller and *Picea excelsa* (Lam.) Link; woody areas dominated by *Castanea sativa* Miller; mixed wood of *Abies alba* Miller, *Acer* spp. *Fagus sylvatica* L. and *Picea excelsa* (Lam.) Link

Bosco dell'Ospedale (Sovicille) 296222; Bosco di S. Agnese (Castellina in Chianti) 286241; Bosconi (Trequanda) 298333; Castello di Tocchi (Monticiano) 307124; Fioreta (Monteriggioni) 296142; Il Casalino - Le Badesse (Monteriggioni) 296114; Il Gallinaio (Monteriggioni) 296141; Il Santo (Monticiano) 307211; Imposto (Monticiano) 307211; La Chiocciola (Monteriggioni) 296142; La Sensanese (Castel S.Gimignano); Leccetella (Murlo) 307121; Libbiano (S. Gimignano) 285212; M.te Morio - Fungaia (Monteriggioni) 296131; Osteria delle Macchie (Monticiano) 307422; Pigelleto - M.te Amiata (Piancastagnaio); Poggio ai Legni (Sovicille) 296133; Ponte a Macereto (Sovicille) 307124; S. Angelo in Colle (Montalcino) 320411; Selvaccia (Siena) 296123; Tra Serre di Rap.e San Gemignanello (Rapolano) 29721/2; Vagliagli (Castelnuovo B.ga) 287333; Vignano (Siena) 297434; Vivo d'Orcia (Castiglion d'Orcia) 320121

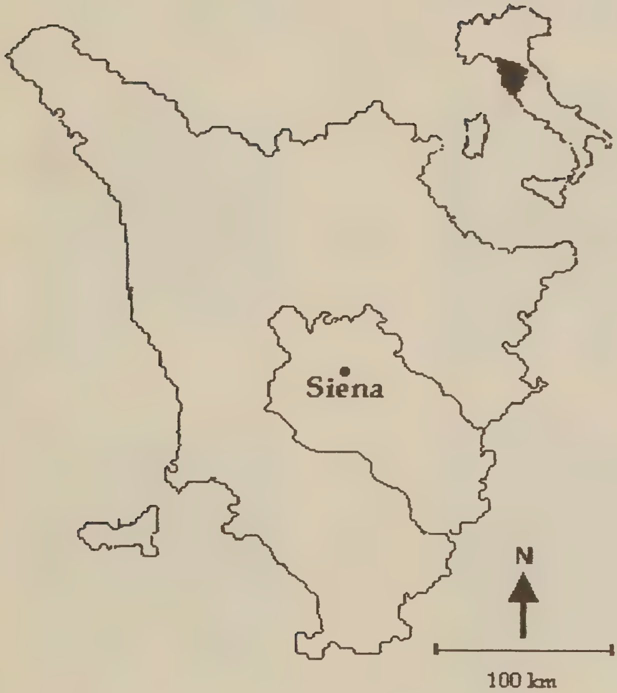
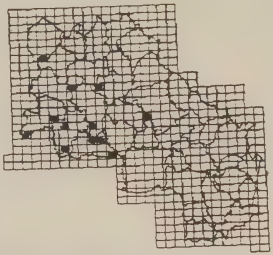
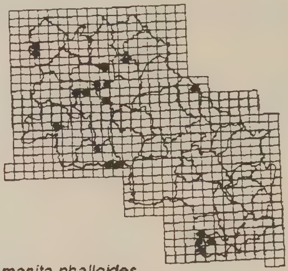

Siena
N
100 km

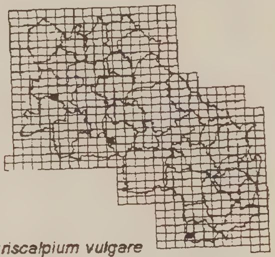
Fig. 1 – Map of Siena Province



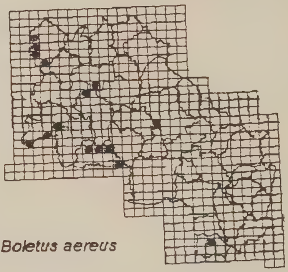
Amanita caesarea



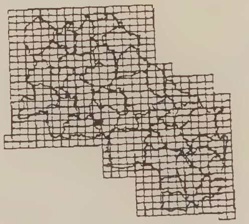
Amanita phalloides



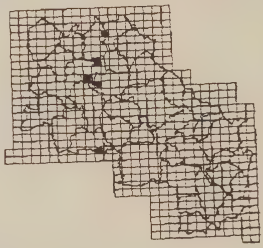
Auriscalpium vulgare



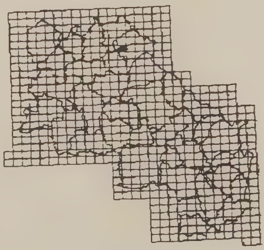
Boletus aereus



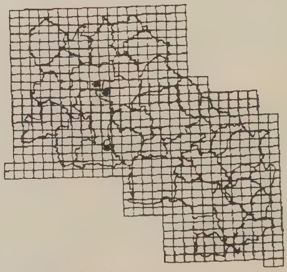
Boletus impolitus



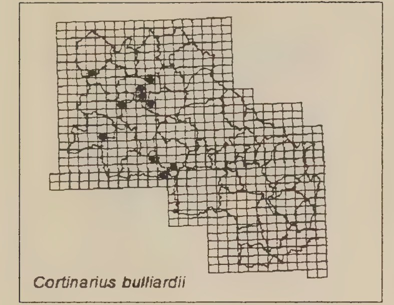
Boletus satanas

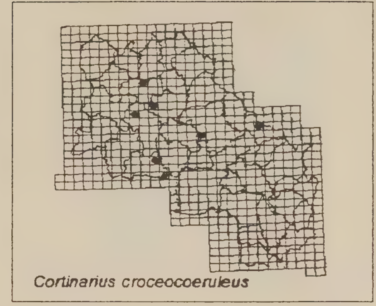


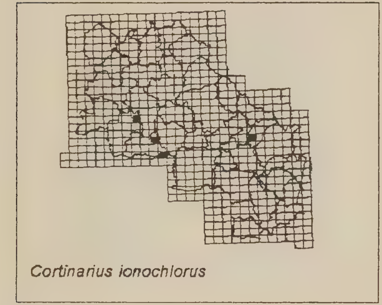
Chroogomphus fulmineus

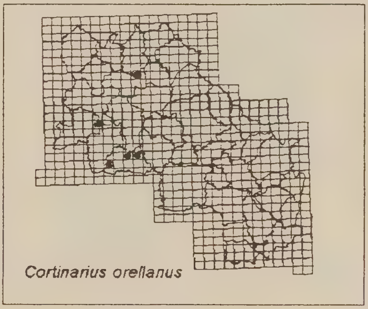


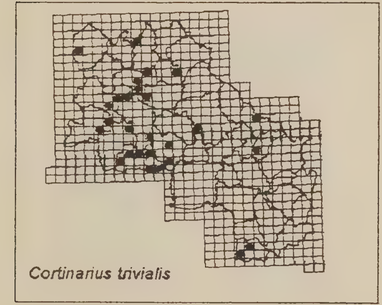
Cortinarius aleuriosmus

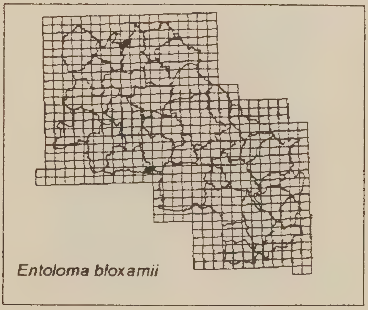

Cortinarius bulliardii

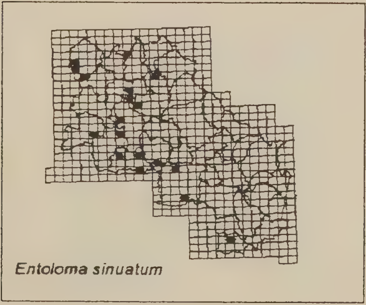

Cortinarius croceocoeruleus

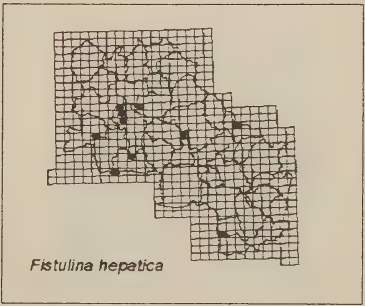

Cortinarius ionochlorus

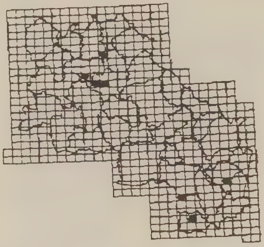

Cortinarius orellanus


Cortinarius trivialis

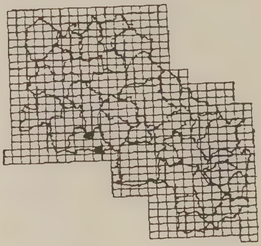

Entoloma bloxamii


Entoloma sinuatum

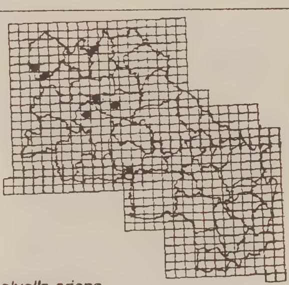

Fistulina hepatica



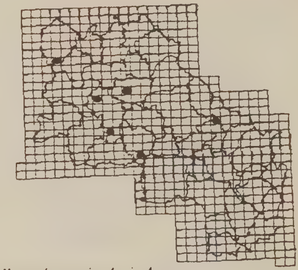
Gyroporus castaneus



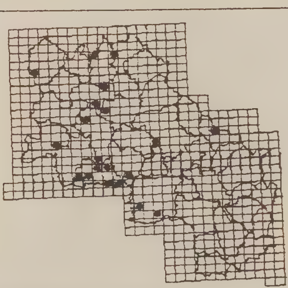
Hebeloma sarcophyllum



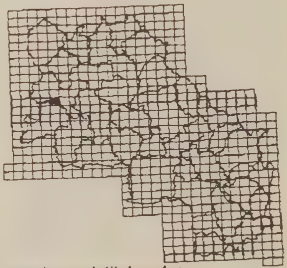
Helvella crispa



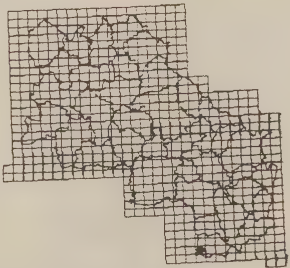
Himeola auricula-judae



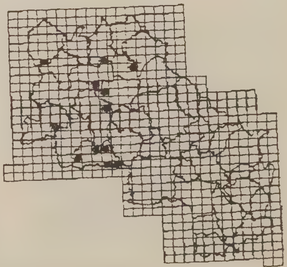
Hydnellum concrescens



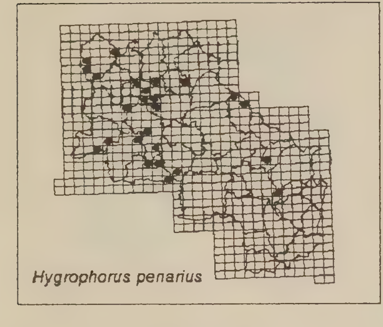
Hygrophorus latitabundus



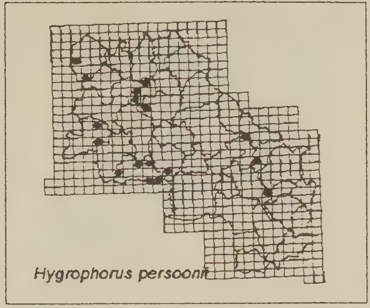
Hygrophorus marzuolus



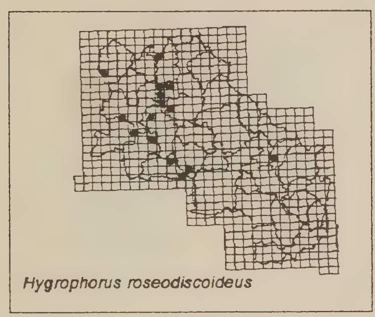
Hygrophorus nemoreus



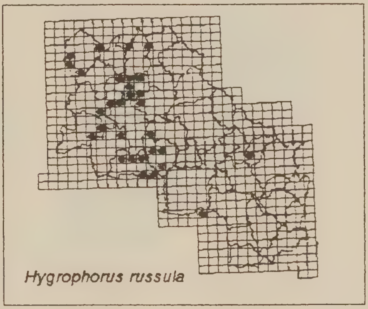
Hygrophorus penarius



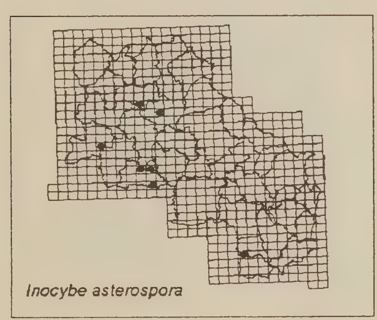
Hygrophorus persoonii



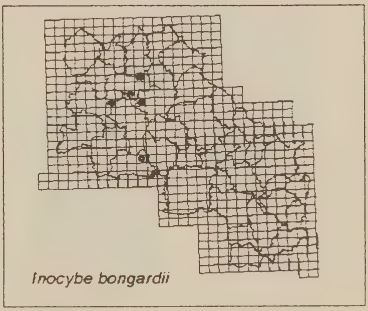
Hygrophorus roseodiscoideus



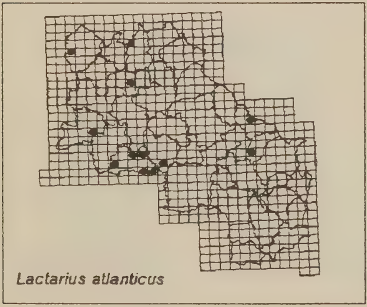
Hygrophorus russula



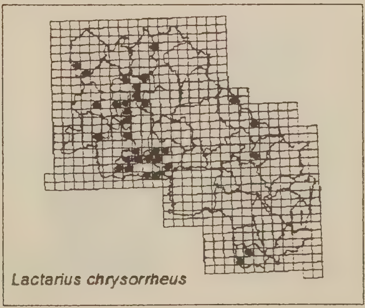
Inocybe asterospora



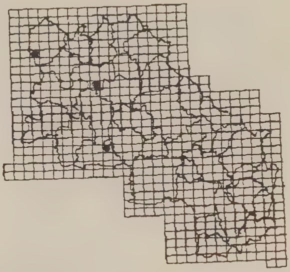
Inocybe bongardii



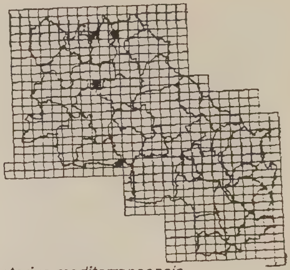
Lactarius atlanticus



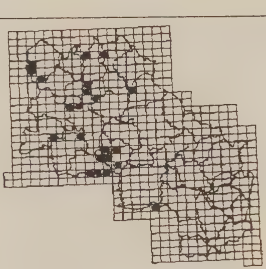
Lactarius chrysorrheus



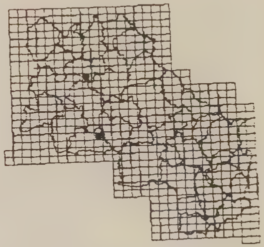
Lactarius ilicis



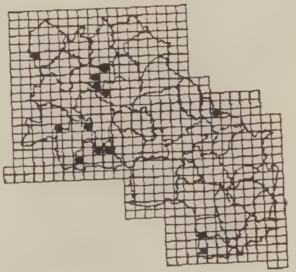
Lactarius mediterraneensis



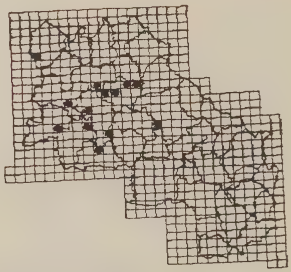
Leccinum lepidum



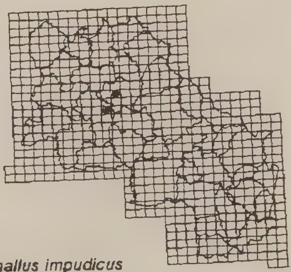
Marasmius alliaceus



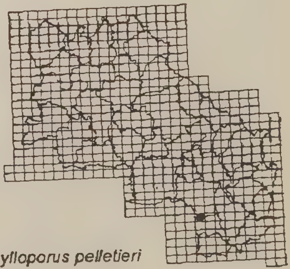
Mycena pelianthina



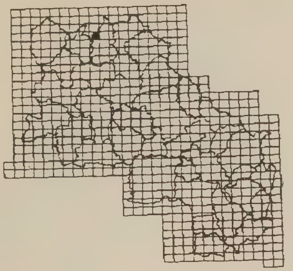
Omphalotus olearius



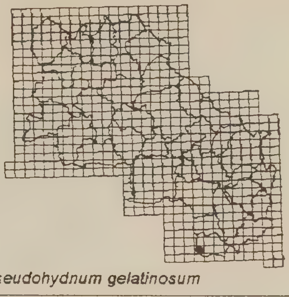
Phallus impudicus



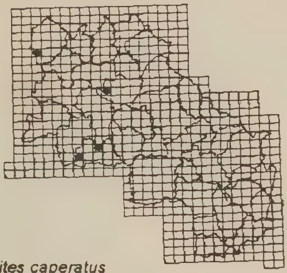
Phylloporus pelletieri



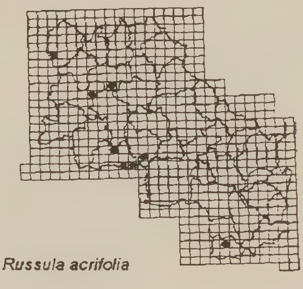
Pisolithus arhizus



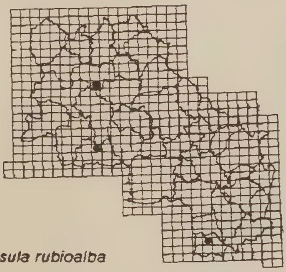
Pseudohydnum gelatinosum



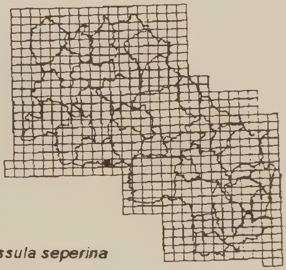
Rozites caperatus



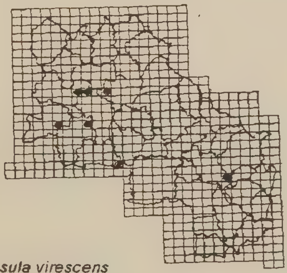
Russula acrifolia



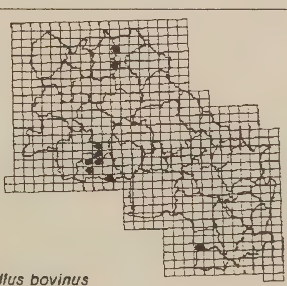
Russula rubioalba



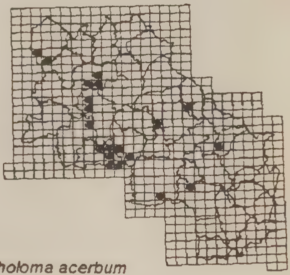
Russula seperina



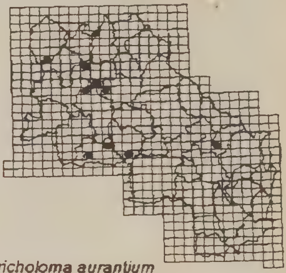
Russula virescens



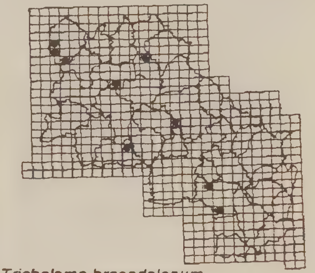
Suillus bovinus



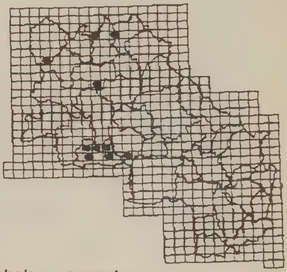
Tricholoma acerbum



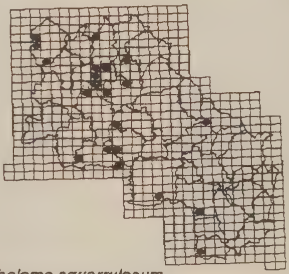
Tricholoma aurantium



Tricholoma bresadolanum



Tricholoma equestre



Tricholoma squarrulosum

Discussion

Survey of field data and the literature indicates that 53 taxa belonging to the list of 66 taxa proposed by the Working Group for Mycology of the Italian Botanical Society have been recorded for the province of Siena (central Tuscany). Failure to find *Tuber aestivum* and *T. rufum* could indicate their absence from the study areas, although our research was only concerned with epigeous fungi.

The absence of the other eleven species (*Amanita porphyria, Cortinarius suaveolens, Entoloma lividoalbidum, Gomphus clavatus, Hebeloma radicosum, Hymenochaete cruenta,* *Lactarius necator, Pycnoporus cinnabarinus, Strobilomyces strobilaceus, Tremiscus helvelloides* and *Verpa digitaliformis*) was probably due to edaphic and climatic limiting factors but also to the fact that many parts of the province of Siena were not investigated.

Most of the 53 species identified were observed in their typical habitat; species such as *Amanita caesarea*, *Boletus impolitus*, *Cortinarius croceocoeruleus*, *C. ionochlorus*, *Hygrophorus russula*, *Lactarius mediterraneensis*, *Leccinum lepidum* and *Russula seperina,* which the literature indicates to be thermophilic (Basso, 1999; Bon, 1983; Bon & Gehu, 1973; Bujakiewicz, 1993; Candusso, 1997; Courtecuisse & Duhem, 1994; Gyosheva & Vassilev, 1994; Orsino & Traverso, 1986), were observed in thermophilious woods with predominantly Mediterranean vegetation. *Entoloma sinuatum*, *Hygrophorus nemoreus*, *Russula rubroalba* and *Tricholoma acerbum*, typically linked to woods of broadleaf trees (Bohus & Babos, 1967; Bon & Gehu, 1964; Candusso, 1997; Courtecuisse & Duhem, 1994; Moser, 1980; Noordeloos, 1992; Riva, 1988) were not observed in conifer woods. Similarly, *Hygrophorus latitabundulus*, *Pseudohydnum gelatinosum* and *Suillus bovinus,* species typically linked to conifer woods (Alessio, 1985; Candusso, 1997; Courtecuisse & Duhem, 1994; Jülich, 1989) were only observed in woods dominated by *Abies alba*, *Picea excelsa* and *Pinus* spp.

The finding of *Boletus aereus*, *B. satanas* and *Hygrophorus penarius* in oak woods on calcareous rocks (Il Casalino – Le Badesse; M.te Morio – Fungaia; S. Colomba – Monteriggioni and La Piramide – S. Leonardo al Lago) confirms the basophilous nature of these species (Alessio, 1985; Bujakiewicz, 1992; Carbiner et al., 1972-73-74; Candusso, 1997; Courtecuisse & Duhem, 1994).

Some species were observed in habitats different from those indicated in the literature, for example, *Auriscalpium vulgare*, *Fistulina hepatica* and *Marasmius alliaceus. A. vulgare* is reported to prefer conifer woods (Lisiewska, 1963; Thoen, 1970-71); the fact that it was found in an evergreen oak wood suggests the existence of nearby conifers. According to Bernicchia (1990), Ryvarden & Gilbertson (1993) and Skubla (1984), *F. hepatica* is linked to *Castanea sativa* and/or *Quercus* spp.; we found it in fir afforestations (Pozzaroni – Abbadia S. Salvatore) where the occasional chestnut tree is, however, to be found. We found *M. alliaceus* in a deciduous oak wood and an evergreen oak wood (S. Colomba – Monteriggioni; P.te a Macereto – Sovicille) but the species is linked to beech according to some authors (Antonín & Noordeloos, 1993; Courtecuisse & Duhem, 1994; Lisiewska & Tortic, 1990; Thoen, 1970; Thoen, 1971). *Hirneola auricula-judae* was found on trunks of *Quercus ilex* and *Arbutus unedo,* in contrast with Courtecuisse & Duhem (1994) and Jülich (1989) who list it as a lignicolous saprophyte on trunks of *Sambucus nigra. Gyroporus castaneus* and *Tricholoma squarrulosum* are species linked to Mediterranean thermophilous woods (Bon & Gehu, 1973) which we also observed in cooler moister woods on Mt. Amiata. On Mt. Amiata, *Inocybe asterospora* was frequent and abundant in *Abies alba* and *Picea excelsa* plantations, whereas the literature indicates it to be an exclusive symbiont of broadleaf species (Courtecuisse & Duhem, 1994; Gyosheva & Vassilev, 1994; Stangl, 1991).

Among the reported taxa the most frequent was *Lactarius chrysorrheus* (109 reports) followed by *Cortinarius orellanus* (93), *Hygrophorus russula* (70) and *Hydnellum concrescens* (56). With regard to the frequency and distribution of *Cortinarius orellanus, Entoloma bloxami* and *Russula seperina,* we confirm the report of Perini & Tofacchi (1999c). Although these species are in the preliminary Italian red-list (Venturella et al., 1997) they should be removed in favour of rarer and endangered species. Fungi such as *Boletus impolitus*, *Chroogomphus fulmineus*, *Hygrophorus latitabundus*, *Phylloporus pellettieri*, *Pisolithus arhizus* and *Russula seperina* may be considered rare for the Siena area. Since they are edible species in high demand, the number of reports of *Amanita caesarea* (14) and *Boletus aereus* (20) may not reflect their real distribution and abundance.

The present study is part of an assessment of fungal biodiversity in the Mediterranean area and provides a useful basis for standardization of distribution data. Detailed information on certain taxa is necessary as a starting point for the formulation of conservation policy as in other European countries.

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NEW OR INTERESTING GREENLAND LICHENS AND LICHENICOLOUS FUNGI V

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ABSTRACT

Eight species of lichens, viz. *Aspicilia aliena, A. supertegens, Buellia crepera, Lobothallia radiosa, Mycoblastus affinis, Rinodina rinodinoides, Umbilicaria aprina* and *Xanthoria fulva*, and one lichenicolous fungus, viz. *Arthonia intexta*, are reported as new to Greenland. Notes on the distribution of all of these species and additionally fifteen interesting taxa of lichens and lichenicolous fungi are given.

Key words: Arthoniaceae, Hymeneliaceae, Mycoblastaceae, Physciaceae, Teloschistaceae, Umbilicariaceae

INTRODUCTION

This paper deals with lichens and lichenicolous fungi of particular taxonomical and phytosociological interest found during a new revision of additional material deposited in herb. C. Most of the specimens have been collected by Dr. Paul Gelting during his leadership of the Arctic Station on Disko from 1946 to 1954. Selected specimens collected by Mogens Skytte Christiansen, Ulrik Søchting and Jens Vahl are included in the investigation. Additional information about interesting lichens collected by Gelting can be found in the following papers: Hansen (1983, 1984, 1986).

LIST OF SPECIES

ARTHONIA INTEXTA Almq. – Central West Greenland: Disko, Asuk, 70°11'N, 53°17'W, alt. 50 m, in the apothecia of unknown host on fragment of sandstone on raised, marine terrace, P. Gelting 18876b.

A.intexta is new to Greenland. It is also known from Europe and North America (Hertel 1969, Triebel 1989, Thomson 1997).

ARTHOPYRENIA PUNCTIFORMIS (Pers.) A. Massal. – Central West Greenland: Disko, Qeqertarsuaq/Godhavn, the Arctic Station, 69°15'N, 53°32'W, alt. 10 m. on twig of *Salix* in fen, P. Gelting 16462b.

A. punctiformis is new to Central West Greenland. It has previously been reported from South West Greenland (Alstrup 1982). The species has a cosmopolitan distribution (Thomson 1997).

ASPICILIA ALIENA (Zahlbr.) Oxner – Central West Greenland: Disko, Qeqertarsuaq/Godhavn, the Arctic Station, 69°15'N, 53°32'W, alt. 18 m, on gneissic rock manured by birds, P. Gelting 15691.

A. aliena is new to Greenland. The species has a circumpolar distribution and has previously been reported from Europe, North America and Russia (Andreev et al. 1996, Thomson 1997).

ASPICILIA HUMBOLDTII (Lynge) J. W. Thomson – Central West Greenland: Disko, Nordfjord, Perdlertuut, 59°58'N, 54°28'W, alt. c. 10 m, on basaltic boulder manured by birds, P. Gelting August 1949.

A. humboldtii is a rare lichen known so far only from a few localities in North East Greenland and North America (Lynge 1940, Thomson 1997). It is new to Central West Greenland.

ASPICILIA ROSULATA Körb. – Central West Greenland: Disko, Qeqertarsuaq/Godhavn, the Arctic Station, 69°15'N, 53°32'W, alt. 25 m and 40 m, respektively, on manured gneissic rock coated with limonite, P. Gelting 31 August 1950; Asuk, 70°11'N, 53°17'W, on siliceous rock, M. Pedersen 1096, Asuk, alt. c. 60 m, on basaltic stones, P. Gelting 18871a.

A. rosulata is new to Central West Greenland. The species has previously been reported from South West and North East Greenland (Lynge 1937, 1940). It has an arctic, circumpolar distribution (Thomson 1997).

ASPICILIA SUPERTEGENS Arnold- Central West Greenland: Disko, Nordfjord, Kugsinerssuaq, 69°55'N, 54°24'W, on basaltic boulder in watercourse, P. Gelting 23 August 1949.

A. supertegens is new to Greenland. It has an arctic-alpine, circumpolar distribution (Thomson 1997).

BIATORA SUBDUPLEX (Nyl.) Räsänen ex Printzen – Central West Greenland: Disko, Nordfjord, c. 69°55'N, 54°25'W, alt. 1-2 m, on mosses in saltmarsh, P. Gelting 25 August 1949.

B. subduplex is new to Disko. The species has been collected by the author in North East and South East Greenland (Alstrup et al. 2000, Hansen 2002). *B. subduplex* probably has a circumpolar distribution. However, the saxicolous collection from Alaska is doubtful (Thomson 1997).

BUELLIA BADIA (Fr.) A. Massal. – Central West Greenland: the foot of Mt. Hassel, the head of the northern branch of Søndre Strømfjord, 67°02'N, 50°40'W, alt. ca. 50 m, on *Melanelia substygia* on gneissic boulder in scree, M. Skytte Christiansen WG-

1343b; Nordre Laksebugt, 69°38'N, 54°49'W, on basaltic rock, P. Gelting 17 August 1949.

B. badia is new to West Greenland. The species is also known from North Greenland, Russia, Europe, Africa, Arabia and New Zealand (Purvis et al. 1992, Andreev et al. 1996, Alstrup et al. 2000, Foucard et al. 2002).

BUELLIA CREPERA (Nyl.) Zahlbr. – Central West Greenland: Eqaluarssuit at Arfersiorfik Fjord, 68°05'N, 51°00'W, alt. 4 m, on gneissic rock, P. Gelting 15853c.

B. crepera is new to Greenland. The species is also known from France (Ozenda & Clauzade 1970, Clauzade & Roux 1985).

BUELLIA ECTOLECHIOIDES (Vain.) Erichsen – Central West Greenland: Christianshåb: Igdluko, 68°49'N, 51°11'W, on S-exposed, gneissic rock, P. Gelting 19075e; Disko, Qeqertarsuaq/Godhavn, Elvebakken, 69°15'N, 53°32'W, alt. 10 m, on basaltic pebble on raised, marine terrace, P. Gelting 18932a; Diskofjord, Storø/Qeqertaq, 69°31'N, 54°06'W, alt. 3 m, on basaltic boulder, P. Gelting 13877.

B. ectolechioides is new to Central West Greenland. It has previously been reported from South West Greenland and is also known from Scandinavia, the Alps and Russia (Santesson 1993, Zhurbenko 1996, Foucard et al. 2002).

COLLEMA OCCULTATUM Bagl. var. OCCULTATUM – Central West Greenland: Disko, Qeqertarsuaq/Godhavn, Østerdalen, 69°15'N, 53°22'W, alt. 25 m, on twigs of *Salix glauca*, P. Gelting 28 March 1950.

C. occultatum is new to Disko. The species has previously been reported from Maarmorilik, where it grows on twigs of *Rhododendron lapponicum* (Alstrup 1982). *C. occultatum* is also known from Europe, Algeria and North America (Degelius 1954, Esslinger & Egan 1995).

DERMATOCARPON MEIOPHYLLIZUM Vain. – South West Greenland: Ujaragssuit, 60°12'N, 44°11'W, on siliceous rock, J. Vahl July 1829.

D. meiophyllizum is new to South West Greenland. The determination has been verified by Starri Heidmarsson, who states that the specimen is not quite typical. The species is also known from North Greenland (Alstrup et al. 2000). In addition it is known from Scandinavia, the British Isles and Central Europe (Heidmarsson 2001).

LECANORA VARIA (Hoffm.) Ach. – Central West Greenland: Disko, Qeqertarsuaq/Godhavn, 69°15'N, 53°32'W, alt. 6 m, on wood from old house, P. Gelting 6 September 1950; on wodden bridge at the harbour of Godhavn, alt. 1m, P. Gelting 8 June 1952.

L. varia is new to Disko. It is widely distributed in South West Greenland and is a common, circumpolar species ranging from temperate to arctic areas (Thomson 1997).

LECIDEA ATROMARGINATA H. Magn. – Central West Greenland: Disko, Asuk, 70°11'N, 53°17'W, alt. 40 m, on fragment of sandstone on wind exposed, raised marine terrace, P. Gelting 18869d.

L. atromarginata is here reported as new to Disko, although there is a previous unpublished collection made by J. Grøntved from Sinigfik just east of Qeqertarsuaq.

The species is widely distributed in West Greenland and occurs so far northwards as Washington Land (Alstrup 1986, Hansen 2001). Few reports of *L. atromarginata* are available from East Greenland (Lynge 1940, Hansen 2002), but the species is apparently fairly common in Peary Land. *L. atromarginata* probably has a circumpolar distribution (Esslinger & Egan 1995), although it has not been reported from Russia so far.

LOBOTHALLIA RADIOSA (Hoffm.) Hafellner – Central West Greenland: Disko, Qeqertarsuaq/Godhavn, 69 15`N, 53 22'W, alt. 40 m, on seepage rock, P. Gelting 17742.

L. radiosa is new to Greenland. The species has a holarctic, circumpolar distribution ranging from the Mediterranean to arctic zone (Esslinger & Egan 1995, Nimis 1993, Andreev et al. 1996).

MIRIQUIDICA LEUCOPHAEA (Flörke ex Rabenh.) Hertel & Rambold – Central West Greenland: Christianshåb, Ikamiut, 68°38'N, 51°50'W, alt. 25 m, on NW.-exposed, gneissic rock, P. Gelting 19471; Qeqertarsuaq/Godhavn, the Arctic Station, 69°15'N, 53°32'W, alt. 20 m, on gneissic boulder manured by snow buntings, P. Gelting 19455; Nuussuaq Peninsula, Saqqaq, 70°01'N, 51°57'W, alt. 15 m, P. Gelting 30 October 1949.

M. leucophaea is new to Central West Greenland. It has previously been reported from North East Greenland (Lynge 1940). It has a circumpolar, arctic-alpine distribution (Thomson 1997).

MYCOBLASTUS AFFINIS (Schaer.) T. Schauer – South West Greenland: Tunugdliarfik, c. 61°N, 45°W, on bark of *Betula pubescens*, J. Vahl 1828.

M. affinis is new to Greenland. It has a circumpolar distribution ranging from boreal to arctic-alpine areas (Thomson 1997).

PERIDIOTHELIA FULIGUNCTA (Norman) D. Hawksw. – South West Greenland: Narssarssuaq, 61°10'N, 45°26'W, alt. 24 m, on *Betula pubescens* in scrub, P. Gelting 25 September 1953.

P. fuliguncta is a non-lichenized species, which is new to Greenland (Diederich & Sérusiaux 2000).

RINODINA PARASITICA H. Mayrhofer & Poelt – Central West Greenland: Upernavik, Amarsortalik Island, 72°35'N, 54°50'W, on the thallus of *Acarospora fuscata*, P. Gelting 23 August 1951.

R. parasitica, which is a very rare Greenland lichen parasite, is new to Upernavik. It has previously been reported from Qeqertarsuaq (Mayrhofer & Poelt 1979). The two specimens were collected by P. Gelting 26 September 1949 and were found growing on *Rhizocarpon geminatum*. *R. parasitica* has a circumpolar distribution, but the species is only rarely collected in arctic areas (Mayrhofer 1984).

RINODINA RINODINOIDES (Anzi) H. Mayrhofer & Scheid. – Central West Greenland: Disko, Qeqertarsuaq/Godhavn, 69°15'N, 53°22'W, alt. 15 m, on S.-exposed rock composed of basalt breccia, P. Gelting 19933.

R. rinodinoides is new to Greenland. The species is also known from Scandinavia, Bavaria and the Alps (Mayrhofer 1984, Scheidegger 1988, Santesson 1993, Hafellner & Türk 2001).

SCUTULA STEREOCAULORUM (Anzi) Körb. – Central West Greenland: Nuussuaq peninsula, Nuussuaq harbour, 70°41'N, 54°35'W, alt. 30 m, on *Stereocaulon rivulorum* on moist slope along brooklet, P. Gelting 15399.

S. stereocaulorum is new to Nuussuaq. The species has previously been reported from many localities between Narssaq and Qeqertarssuaq in West Greenland (Alstrup & Hawksworth 1990). It has a circumpolar distribution ranging from temperate to arctic areas (Esslinger & Egan 1995, Andreev et al. 1996, Santesson 1993).

STAUROTHELE FISSA (Taylor) Zwackh – Central West Greenland: Disko, Fortunebay, Igdluruneq, 69°16'N, 53°49'W, 15 m, on gneissic rock in watercourse, P. Gelting 15635; Diskofjord, Eqalunguit, 69 33'N, 53 36'W, alt. 2 m, on gneissic boulder in watercourse, P. Gelting 16 August 1949.

S. fissa is new to Disko. The species has previously been reported from Nuussuaq peninsula and North East Greenland (Lynge 1937, 1940, Alstrup et al. 2000). It is also known from Europe and North America (Thomson 1997).

TONINIA ROSULATA (Anzi) H. Olivier – South West Greenland: Ameralik, "Iglorsoit", c. 64°00'N, 51°00'W, on mosses, J. Vahl July 1831. – Central East Greenland: Danmarks Ø, Hekla Havn, c. 71°00'N, 25°00'W, on *Collema sp.*, N. Hartz November 1891.

T. rosulata is new to Central East Greenland. It has previously been reported from North East Greenland (Alstrup et al. 2000), and a few collections are available from more southern parts of Greenland (Timdal 1991). Vahl´s collection from Ameralik closes the big gab between Disko and South Greenland. The species is also known from Europe and Russia (Timdal 1991, Zhurbenko 1996).

UMBILICARIA APRINA Nyl. – Central West Greenland: Disko, Skarvefjeld, 69°17'N, 53°33'W, on basaltic rock, U. Søchting 20 August 1977.

U. aprina is new to Greenland. The species has a bipolar and disjunct distribution. It is known from Scandinavia, North America, Ethiopia and Antarctica (Thomson 1997, Kappen & Schroeter 2002).

XANTHORIA FULVA (Hoffm.) Poelt & Petutschnig – Central West Greenland: Mt. Hassel, the head of the northern branch of Søndre Strømfjord, 67°02'N, 50°40'W, alt. 50 m, on dead branches of *Salix glauca* on S-exposed loess slope, M. Skytte Christiansen WG-7576 758.

X. fulva is new to Greenland. The species has a wide distribution in Europe (Poelt & Petutschnig 1992).

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GLOMUS SPINULIFERUM, A NEW ORNAMENTED SPECIES IN THE GLOMALES

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SUMMARY

Glomus spinuliferum forms globose to subglobose, dark yellow to orange brown spores in the soil and occasionally in roots of plants. Spores are 110-154 µm broad and have one wall consisting of 4 layers. The outer wall layer is hyaline and 1-2 µm thick. It may occasionally swell up to 50 µm in mounting media containing lactic acid. Wall layer 2 is very thin and hyaline and densely packed with spines up to 2 µm long which grow into wall layer 1. Wall layer 2 is tightly attached to layer 3, which is dark yellow to orange brown, laminated, and (6-)9-15 µm thick. The thin wall layer 4 is semi-flexible, hyaline to dark yellow and sometimes hard to see. The pore of the spore is often open but usually closed by wall layer 4 or by wall thickening of layer 3 and occasionally by a bridging septum originating from the laminated layer. The hyphal attachment is 8-15 µm broad, having several septae at some distance from the spore base. The new species is the second Glomalean fungus - after *G. caesaris* - that has been newly described from the nature reserve Kaiserstuhl in Germany.

ZUSAMMENFASSUNG

Eine neue Art in den Glomales wird beschrieben. *Glomus spinuliferum* bildet im Boden, und gelegentlich auch in Wurzeln, kugelförmige, dunkel gelbe bis orange braune Sporen von 110-154 µm Durchmesser. Die Sporen besitzen 4 Wandschichten. Die erste Wandschicht ist hyalin und 1-2 µm dick. Sie schwillt gelegentlich bis zu 50 µm in milchsäure-basierten Medien an. Die zweite Wandschicht ist sehr dünn, hyalin und besitzt eine typische, dichte, bürsten- oder nadelförmige Ornamentierung. Die 'Nadeln' sind ca. 2 µm lang und reichen in die erste Wandschicht hinein. Wandschicht 2 sitzt dicht auf der dritten, pigmentierten Wandschicht auf. Wandschicht 3 ist laminiert und (6-)9-15 µm dick. Die vierte Wandschicht ist dünn und hyalin bis dunkel gelb. Die Pore an der Sporenbasis erscheint oft offen, sie kann aber auch durch die Wandschicht 4 oder durch Wandverdickung von Schicht 3 und gelegentlich durch ein Septum, das von der dritten Wandschicht gebildet wird, verschlossen werden. Der Hyphenansatz ist 8-15 µm breit. Die neue Art ist nach *G. caesaris* der zweite arbuskuläre Mykorrhizapilz, der vom Naturschutzgebiet Kaiserstuhl, aus Deutschland, beschrieben ist.

INTRODUCTION

During studies on diversity of arbuscular mycorrhizal fungi (AMF) under different cropping systems in the Upper Rhine Valley of Germany, soil samples were taken from the rhizosphere of an extensive grassland. The site belongs to the Kaiserstuhl nature reserve, near the village Vogtsburg. Its vegetation is classified as a Meso-Brometum ('Kalkmagerrasen') according to Ellenberg (1996). This volcanic area is covered by periglacial Loess sediments. The diversity of plant species of the site has more than 90 plant species; more than 20 Glomalean species were identified in an area of 400 m^2. One of the fungal species is new and is described here.

MATERIALS AND METHODS

Soil cores (sampling depth up to 10 or 70 cm) were taken in March (10 cm) and October (70 cm) 2000 and in June (10 cm) 2002 from the study site. Several bait cultures were established in April and December 2000. Pots (300x200x200 mm) with a 20 mm thick drainage mat were filled with 3 kg of autoclaved substrate (Terragreene-loess mixture; 3:1; pH-H_2O 6.7; available P (Na-acetate) 0.6 mg kg^{-1}; available K (Na-acetate) 42 mg kg^{-1}). The mycorrhizal inoculum (nine 20 g cores of field soil per pot) was placed at the surface and covered with another kg of autoclaved substrate. Three two-week-old seedlings of *Lolium perenne* L., *Trifolium pratense* L. and *Plantago lanceolata* L. were randomly planted into every pot. Each plantlet of *Trifolium pratense* received 1 ml of a 1:5 diluted overnight culture of *Rhizobium trifolii* (DSM 30138, from DSMZ-Deutsche Sammlung von Mikroorganismen und Zellkulturen GmbH, Braunschweig, Germany), grown on a rotary shaker in DSMZ 98 medium at 27°C) An automated watering system (Tropf-Blumat, Weninger GmbH, A-6410 Telfs) was installed and the spore formation was monitored in the bait cultures throughout the two subsequent years.

All attempts to grow *G. spinuliferum* in bait or pure cultures failed. Thus, all observations of its spores had to be based on specimens obtained from the field site in different seasons and years (see above). Morphological properties of spores and their structures were observed on spores mounted in polyvinyl alcohol-lactic acid-glycerol (PVLG; Koske and Tessier, 1983), a mixture of PVLG and Melzer's reagent (Brundrett et al., 1994), a mixture of lactic acid to water at 1:1, Melzer's reagent, and water only. The terminology of spore structures is that suggested by INVAM (International Culture Collection of Arbuscular and Vesicular-Arbuscular Endomycorrhizal Fungi, see homepage: www.invam.caf.wvu.edu). Specimens mounted in PVLG and the mixture of PVLG and Melzer's reagent were deposited in the herbaria indicated below.

LATIN DIAGNOSIS

Glomus spinuliferum sp. nov. Sieverd. & Oehl (Figs. 1A-1D)

Sporocarpia ignota. Sporae flavae vel fulvae, globosae vel subglobosae, 110 – 154 µm in diam. Tunica sporarum cum stratis quatuor:. Stratum primum hyalinum, in aqua 1-2 µm crassum, interdum in substrato cum acido lactico usque ad 50 µm intumescens. Stratum secundum hyalinum, tenue, cum spinulis densis ornatum; spinae 1-2(-3) µm altae et 1.5 µm latae. Stratum tertium flavum ad fulvum, laminatum, (6-)9-15 µm crassum, strato secundo adhaerens. Stratum quartum semiflexibile, strato tertio plerumque arcte adhaerens, 0.5-1.0 μm crassum. Septum in porum rarum visibile est. Hypha adhaerenta communis singula, 8-15 μm diam ad coniunctio, augmentat a 15-21 μm en distantiam 30-45 μm et minnet en distantiam 45-100 μm. En hypham adhaerentam stratum tertium septa formant en distantiam 30-100 μm ad sporam. Formans sporae in solum et radicem. Typus hic designatus:. #01070702: Z+ZT

DESCRIPTION

Sporocarps unknown.

Spores formed singly in soil (Fig. 1 A) or occasionally in roots, dark yellow to orange brown, globose to subglobose, (110-)120-140(-154) μm diameter with 60% in the range of 130-140 μm. Some spores have debris (up to 80 μm thick) around the hyphal attachment.

Spore wall consisting of one wall group with four layers (sw1-sw4) (Fig. 1 B). Outer layer (sw1) hyaline to cream-white, 1-2 μm thick, evanescent; occasionally swelling up to 50 μm in lactic-acid-based mountants, generally disappearing in older spores. Sw2 hyaline, < 0,5 μm thick, covered with fine spines generally 1-2(-3) x 1.5 μm which grow into wall layer sw1; spines densely packed with no or with space of smaller than 1 μm (Fig. 1 C). Sw2 is tightly adherent to sw3 which is dark yellow to orange brown and finely laminated, (6-)9-15 μm thick and often thickest near hyphal attachment. Sw4 is hyaline to concolorous with sw3, thin (0.5-1 μm), semi-flexible and usually tightly adherent to sw3, so that it hardly can be seen. When very thin (about 0.5 μm) and separating, often several folds of sw4 can be observed, when thicker, sw4 is of solid appearance. None of the layers reacting to Melzer's reagent.

Subtending hypha generally persistent to spore, up to 100(-200) μm long to the point where the hypha is broken, straight or curved, frequently constricted at the spore base (Fig. 1 C). Subtending hypha 8-15(-20) μm broad directly at its attachment to the spore and often up to 6 μm thicker a short distance (30-45 μm) from the attachment, beyond which it decreases. Wall layers of the subtending hypha continuous with spore wall layers sw1-sw3; sw4 once observed in the subtending hypha. Hyphal wall at point of attachment 4 to 8 μm thick, decreasing to 2-3 μm about 30-50 μm from the base; outer layer hyaline and often present up to 100 μm from the base, inner layer light-yellow to yellow-brown andvisible up to 50 μm from the base, then becoming hyaline. Spiny ornamentation of sw2 of the subtending hypha often visible in where this wall is pigmented, but sometimes reaching only a few μm from the spore base into the subtending hypha.

Pore at point of hyphal attachment often only 1 μm wide, usually closed by sw4 (Fig. 1 D) and thickening of sw3 or a bridging septum originating from sw3. Inner wall layer sw4 and septum often difficult to observe at spore base. Within the subtending hypha one or several septae curved towards the spore base often detectable 30 μm to 100 μm from the spore base (Fig. 1 A).

Mycorrhizae formation unknown.

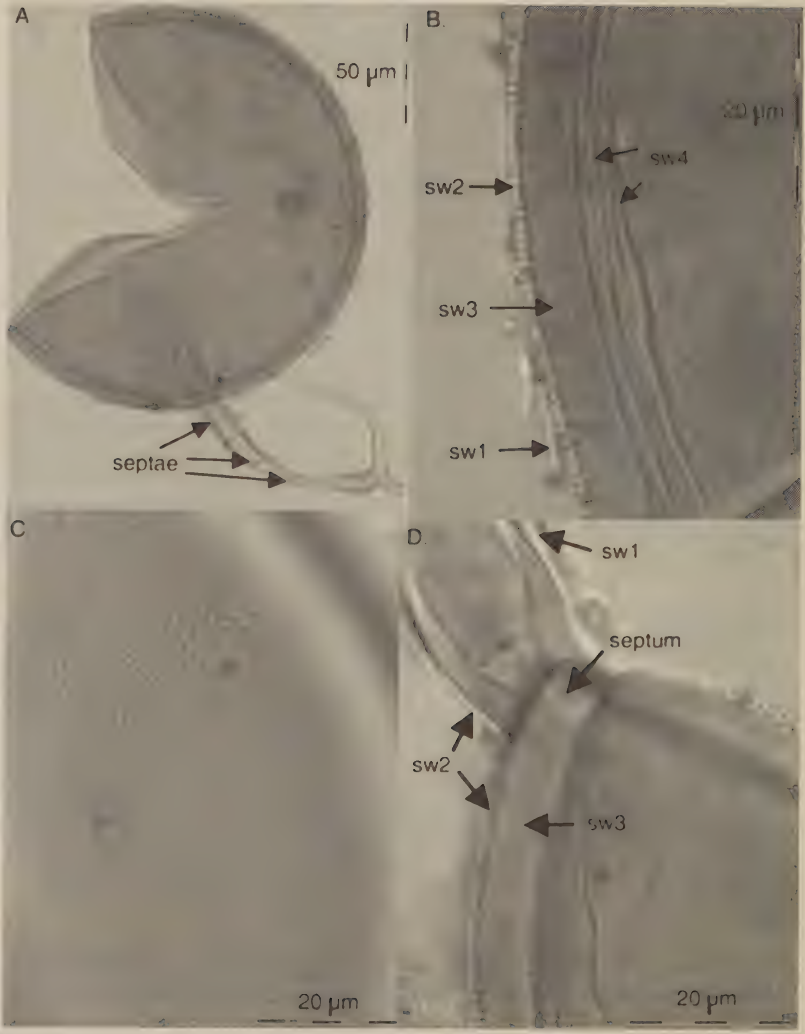
A
50 µm
septae
B.
20 µm
sw4
sw2
sw3
sw1
C
20 µm
D.
sw1
septum
sw2
sw3
20 µm

Figure 1: Morphological spore characteristics of *G. spinuliferum* spores mounted in PVLG: A. Broken spore showing debris on the outer surface and several septae in the subtending hypha. B. Spore wall layers sw1-sw4. C. Plan view of the ornamentation of sw2. D. Spore base with septum and the hyphal attachment.

Etymology: Latin, spinuliferum ('bearing minute spines') referring to the spiny ornamentation of the second wall layer.

Type: Obtained from a soil sample originating from a semi-natural grassland at Vogelsang Pass near Vogtsburg, belonging to the Kaiserstuhl Nature Reserve, Germany. Holotype here designated: Slide Nr. 01070702: Z+ZT; Isotypes: FB, OSC.

Distribution: *Glomus spinuliferum* has only been isolated from species rich Meso-Brometum at the type locality.

DISCUSSION

Ornamentation of at least one of the spore wall layers is common in most genera of arbuscular mycorrhizal fungi, (e.g. in *Acaulospora* Gerd. & Trappe and *Scutellospora* C. Walker & Sanders). In *Glomus*, however, only about 5 % of the described species have an ornamented spore wall layer. From these AMF species, *Glomus spinuliferum* can be easily separated by the position and the characteristics of the ornamentation, the spore wall colour and the spore wall structure.

Spores of *G. spinuliferum* are dark yellow to orange-brown and have four wall layers in one wall group. The ornamentation is positioned on wall layer sw2 consisting of densely packed spines, 1.5-2(-3) μm long and 0.5-1 μm apart. Spores of *G. dominikii* Blasz. (Blaszkowski, 1988), *G. scintillans* S. L. Rose & Trappe (Rose and Trappe, 1980) and *G. chimonobambusae* Wu & Liu (Wu et al., 1995) are hyaline to white and appear to have two spore wall groups, a feature that is not typical for *Glomus* species. Their ornamentation is positioned on the outer surface of the outer spore wall layer.

Size and colour of *G. verruculosum* Blasz., *G. pustulatum* Koske, Friese, C. Walker & Dalpé, *G. multiforum* Tadych & Blasz., *G. monosporum* Gerd. & Trappe and *G. pansihalos* S. M. Berch & Koske spores may overlap with those of *G. spinuliferum*, but their spore walls consists of fewer layers and the ornamentation is distinctly different. *Glomus verruculosum* has evenly distributed warts projecting inward from the innermost layer (Blaszkowski and Tadych, 1997), *G. pustulatum* (Koske et al. 1987) produces circular or irregular, blister-like areas on the outer surface (up to 7 μm high and 38 μm across) and the laminated layer sw3 of *G. multiforum* is evenly pitted with 2-4 μm round or rarely ovate depressions 1.5-3 μm deep of separated by ridges, 1.5-6.6 μm wide (Blaszkowski and Tadych, 1997).

The ornamentation of *G. monosporum* spores is said to consists of 'minute, abundant to scattered echinulations' that protrude from the laminate layer into the outer wall (Gerdemann and Trappe, 1974). *Glomus spinuliferum* spores differ from them by a more pronounced ornamentation due to significantly longer spines. Moreover, spores of *G. monosporum* are generally broader, their spore walls are thinner, and the spores are produced in sporocarps.

The ornamentation of *G. pansihalos* (Berch and Koske, 1986) is positioned on the outer surface of the laminate, pigmented layer as in *G. spinuliferum*. However, it consists of hemispherical warts that are smaller (1 x 1 x 1 μm) and more widely spaced (1-5 μm apart) than in *G. spinuliferum*. In lactic acid mounts, they appear as vertical striations in the expanding (up to 100 µm) outermost spore wall layer.

Spores of *G. spinuliferum* isolated from field soils can be mistaken for spores of *G. macrocarpum* Tul. & Tul. C. (Berch and Fortin, 1983) when observed in a dissecting microscope. Both species share similar size and color. In a compound microscope with transmitted light and at higher magnification, spores of *G. spinuliferum* are easily distinguished from those of *G. macrocarpum* by the ornamentation of wall layer sw2.

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CALOPLACA COERULEOFRIGIDA SP. NOVA, A LICHEN FROM CONTINENTAL ANTARCTICA

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Abstract: *Caloplaca coeruleofrigida* Søchting & Seppelt is described from Southern Victoria Land, continental Antarctica. It is characterized by vertically elongated papillae and a pale orange pigmentation on shaded parts, and black thallus and apothecia on exposed parts of the thallus.

Keywords: *Caloplaca*

Introduction

The lichen flora of Antarctica was recently comprehensively treated by Øvstedal and Smith (2001). They recorded 27 species of *Caloplaca* and four species of *Huea* from Antarctica. Most of these species grow in the mesic climate of the maritime Antarctic, whereas continental Antarctica has a more limited number of species. The maritime Antarctic South Shetland Islands are the most thoroughly studied and probably support the richest lichen flora in the Antarctic region. However, detailed studies of the vegetation of continental regions have also revealed new species of the genus *Caloplaca* (Søchting & Øvstedal 1998, Søchting & Olech 2000). The genus *Caloplaca* (including *Huea*) in Antarctica has been treated in several papers (Søchting & Øvstedal 1992, 1998, Søchting & Olech 1995, 2000, Olech & Søchting 1993, Castello & Nimis 1995) and considering that there are a number of taxa that are as yet undescribed it may turn out to be the lichen genus with the highest species number in Antarctica.

This paper describes a characteristic new species of *Caloplaca* from continental Antarctica that develops very differently depending on exposure to light.

***Caloplaca coeruleofrigida* Søchting & Seppelt spec. nova** (Figs. 1-3).

Caloplaca tiroliensi similis, sed thallus saxicola et areolae in umbra microlobos verticales formantes.

Type: ANTARCTICA: SOUTHERN VICTORIA LAND: Granite Harbour, 1 km W of Cape Geology, 77°00' S, 162°34' E, 20 m alt., on small stones in rubble in block boulder field at lower end of coastal slopes, 11 January 1992 *R. D. Seppelt 19864*. (C-holotype, ADT-isotype)

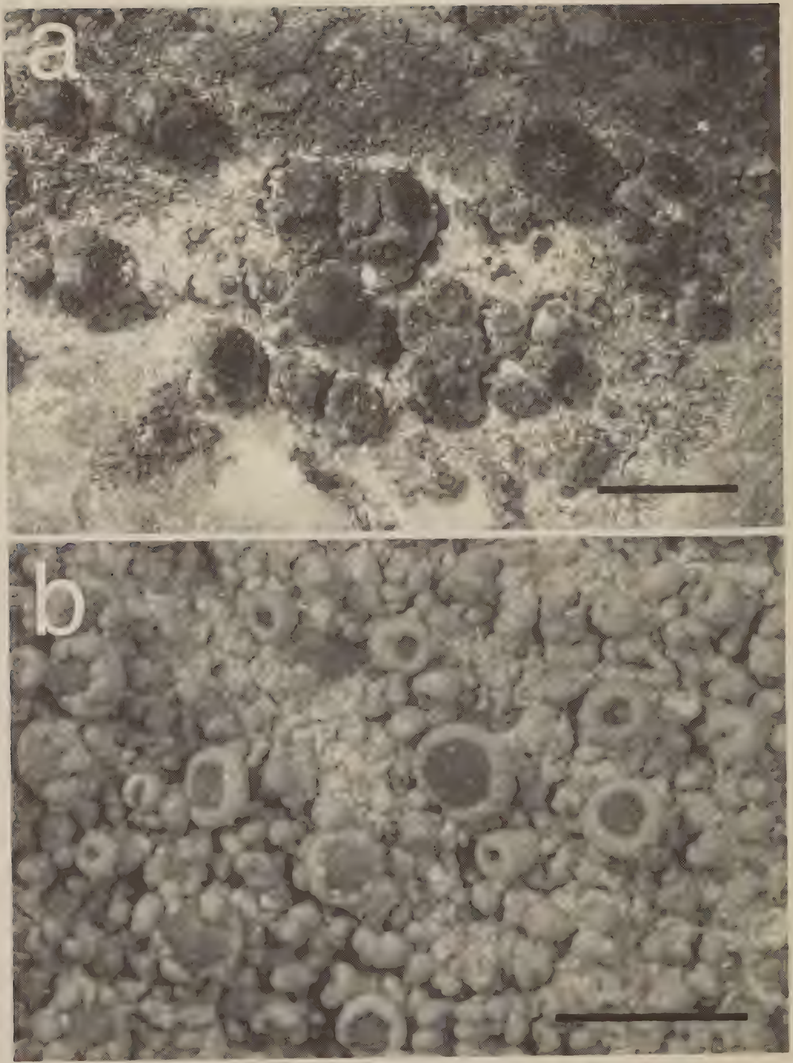

Fig. 1. *Caloplaca coeruleofrigida* Holotype. Habitus. a. exposed thallus; b. shaded thallus. Scale 1 mm.

Thallus saxicolous, 0.2 mm thick, effuse, up to several cm across, consisting of horizontal, somewhat incised areoles that are partly developed into aggregates of short, more or less erect, coralloid lobes, dark bluish grey to black, often with an ochre-yellowish tinge and sometimes with whitish pruina. Hypothallus conspicuous, black, visible between the areoles and in the thallus periphery.

Apothecia lecanorine to zeorine, numerous, dispersed to crowded, mostly narrowly sessile, up to 0.8 mm diam., developing from the areoles. Disk flat to slightly convex, in exposed positions jet black, in more sheltered positions with an orange tinge or even pale orange when very shaded; epipsamma, when visible, fine. Margin thick, initially often prominent, eventually almost level with the disk. Thalline margin often well developed, irregularly carved to crenulate, concolorous with the thallus areoles. Proper margin initially obscure, but on older exposed apothecia dominant, black as the disk (fig. 1).

Areoles heteromerous with a basal dark emerald layer, about 50 µm thick, consisting of anticlinal, thin-walled hyphae, 2 µm thick. Upper cortex paraplectenchymatous, 25-30 µm thick, when exposed with an amorphic emerald pigment overlaid by a necrotic layer, 5 µm thick.

Thalline excipulum well-developed on shaded apothecia, 100 µm thick, with many algae and a well-defined paraplectenchymatous cortex with fine epipsamma (fig. 2b). Proper excipulum insignificant, 10 µm thick on shaded apothecia, but on exposed apothecia it is well-developed, up to 70 µm thick, fan-shaped with anticlinal, prosoplectenchymatous tissue of textura prismatica. Lateral cell lumina 10 x 2 µm, with brownish black pigmentation of the cell walls, particularly the outer cell walls (fig. 2a). Hypothecium without oil-droplets. Hymenium *c.* 65 µm high. Paraphyses 1-2 µm thick, simple, apically inflated, up to 4,5 µm thick (fig. 3a), on shaded apothecia with fine epipsamma and on exposed apothecia with a cap of amorphous emerald pigment, K-. Asci with 8 spores. Spores polarilocular, (13.5-)14-15(-17) x 6-8 µm. Septum 4-5 µm (fig. 3b). Pycnidia numerous, immersed apically in the areolae, brownish; pycnoconidia bacilliform, 2.5 x 1 µm.

Chemistry: Parietin: 90 %, teloschistin: 1 %, fallacinal 3 %, parietinic acid: 4 %, emodin: 1 % (measured as relative absorbtion area at 270 nm). Type A of Søchting (1997), C-. Orange parts on cortex and epithecium (epipsamma) K+red. Emerald pigment K-, C-.

Etymology: The species is named coeruleofrigida meaning the blue frozen one.

Discussion

The holotype grows on both upper and lower sides of two pebbles. On the lower sides the areoles are regularly scattered, papillate to vertically elongated and somewhat coralloid; the colour is beige to pale orange and the disks are orange without a trace of black. On the strongly exposed upper side the apothecia are totally black, but on the edge of the pebbles it is seen that the exposed parts of the apothecia are blackened, whereas the shadowed parts are developed as on the lower side of the pebble. This blackening, due to exposure, is shared with a number of polar *Caloplaca* species, e.g. *C. exsecuta, C. tiroliensis* and *C. ammiospila* (Hansen, Poelt & Søchting 1987). Like these species, *C. coeruleofrigida* does not belong to the true non-anthraquinone producing species, such as *C. cerussata* and *C. coralligera* that never produce orange or yellow anthraquinone crystals.

The metabolite syndrome conforms to syndrome A of Søchting (1997), which it shares with numerous species of *Caloplaca*. The strong blackening of the apothecia distinguishes it from the variable *Caloplaca holocarpa* group, and the broad spore septum from *Caloplaca frigida*.

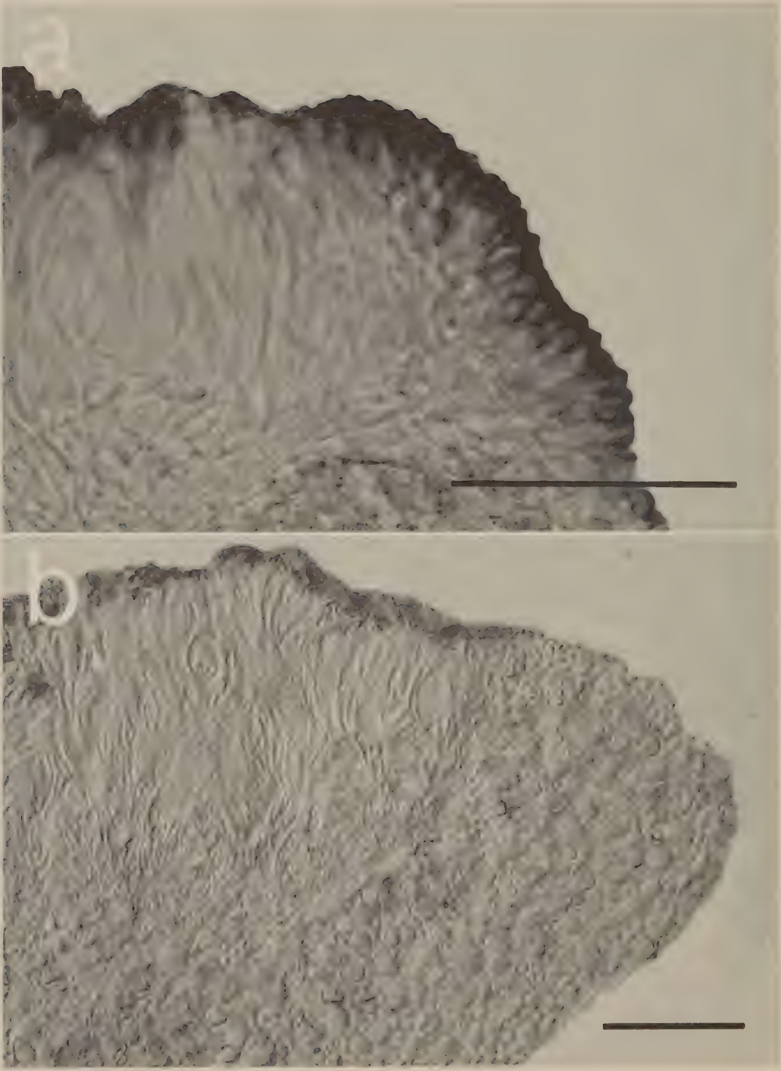

Fig. 2. *Caloplaca coeruleofrigida*. Holotype. Section of margin. a. light exposed apothecium; b. shaded apothecium. Scale 50 μm.

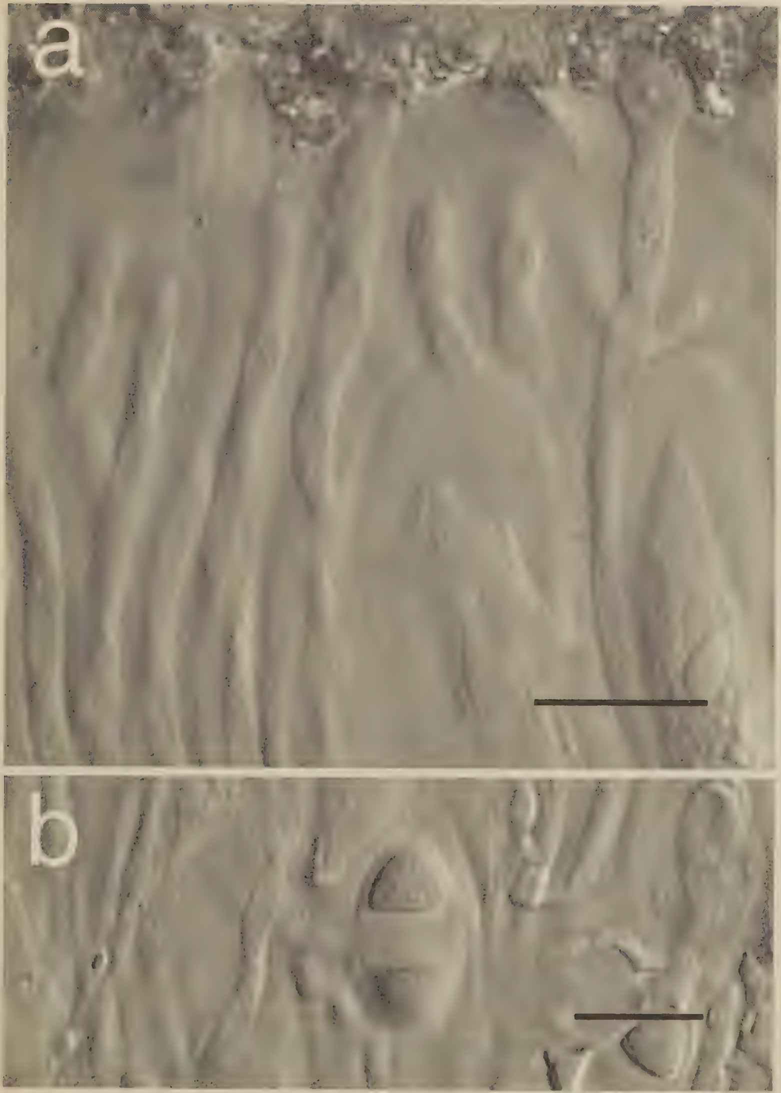

Fig. 3. *Caloplaca coeruleofrigida*. Holotype. a. hymenium with paraphyses. Scale 10 µm; b. spore. Scale 5 µm.

The very characteristic thallus areoles, combined with its occurrence in continental Antarctica make it highly unlikely that is has been described before, and we are not aware of any similar species in cold regions. A base sequence from the ITS region of nuclear rDNA extracted from the species does not show any close relationship to any other *Caloplaca* species group that we have sequences from (data not shown), so its position within the genus *Caloplaca* is presently unclear.

Ecology and Distribution

Caloplaca coeruleofrigida occurs relatively abundantly in the Cape Geology region of Granite Harbour, growing on rock in ephemerally wet or humid habitats, particularly along melt water courses. On Ross Island, Southern Victoria Land, other *Caloplaca* species are also known to occur abundantly in similar habitats, particularly along linear frost cracks where drift snow accumulates or melt water percolates. Collections made so far have all been from 20 to around 60 m altitude. Most of the collections have been from north-facing slopes. At present, the species is only known from Southern Victoria Land in the Botany Bay-Cape Geology area of Granite Harbour, and from the nearby Couloir Cliffs.

Additional specimens examined: ANTARCTICA: SOUTHERN VICTORIA LAND: Granite Harbour, slopes approximately 1 km west of Cape Geology, 77° 00' S, 162° 34' E, 20-25 m alt., on frost fractured granitic blocks with *Buellia frigida* on ledges subject to melt seepage, near skua gull roost, 11 January 1992 *Seppelt 19863* (ADT); Granite Harbour, 1.5 km West of Cape Geology. 77° 00' S, 162° 33' E, 10-12 m alt., upper boulder beach terrace, on stones in rock debris on boulder slope, 21 January 1992 *Seppelt 19865* (ADT); Couloir Cliffs, 77° 01' S, 162° 48' E, on stone in melt channel, 1 December 1994 *Seppelt 19740* (ADT).

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PROPOSING MORGANELLA SUBGEN. APIOPERDON SUBGEN. NOV. FOR THE PUFFBALL LYCOPERDON PYRIFORME

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Summary: The puffball genus *Morganella* (Lycoperdaceae) is emended to include a new subgenus *Apioperdon. Lycoperdon pyriforme* is relocated to *Morganella*, yielding the new combination *Morganella pyriformis*, and an epitype is given.

Keywords: Basidiomycotina, capillitium, DNA, gasteromycetes, phylogenetics

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INTRODUCTION

Lycoperdon pyriforme SCHAEFF.: PERS., the Stump Puffball or Pear-Shaped Puffball (*Lycoperdon* section *Lycoperdon*, series *Pyriformia* KREISEL 1962), is a well-known puffball that grows on decayed wood. As such it is quite distinct, especially in regions where no other lignicolous Lycoperdales occur. Distinguishing macroscopical features include a permanently white subgleba and white mycelial strands at the base. The basidiospores have warts that are almost invisible using the light microscope unless observed in an air bubble, and the capillitial threads are not pitted. The exoperidial exostratum contains spherocytes with finger-like protuberances (DEMOULIN 1972). SEM images of *L. pyriforme* basidiospores (Fig. 1) reveal widely separated warts less than 0.5 µm high (see also PEGLER et al. 1995).

Two different analyses of nuclear ribosomal DNA sequences – one an earlier study published by KRÜGER et al. (2001) and another detailed below – imply a wide separation between *L. pyriforme* and other *Lycoperdon* species and lend support for transferring *L. pyriforme* to the lignicolous genus

Morganella Zeller (Mycologia 40:650, 1948, emend. Kreisel & Dring, Feddes Repertorium 74:109, 1967). The second phylogenetic analysis was prompted by J.E. Wright (pers. comm.) who determined that a recent South American collection represents an unknown taxon with affinities with *L. pyriforme* [PARAGUAY: ALTO PARANÁ, 25 May 2001, leg.: R.H. Petersen, collection *11246* (TENN58935), GenBank ITS region rDNA sequence AF479762]. In our new analysis (see below) we also included two other sequences from an immature specimen of *Calvatia* from Argentina (TENN59078; AF485064) and *Morganella fuliginea* from Paraguay (TENN59070; AF485065), both determined by Wright.

METHODS

DNA extraction and sequencing followed the methods outlined by Krüger et al. (2001, 2002) using ITS5 and ITS3 as sequencing primers (White et al. 1990). Contig assembly was done manually in a text editor, and alignment in BioEdit v. 5.0.9 (Hall 1999). The three new sequences (AF479762, AF485064, AF485065) introduced above were complemented with two recent GenBank additions (AB067724, AB067725; Terashima et al. 2002) and combined with the data used to generate the phylogenetic tree in Fig. 4 of Krüger et al. (2001). After creating a MEGA2 file with ForCon v. 1.0 (Raes & van de Peer 2002) the alignment was opened in the data explorer of MEGA2 (Kumar et al. 2001) and reduced from 664 aligned sites. This alignment now containing 70 parsimony-informative sites was then converted to PC-NEXUS format via SeqVerter v. 1.571 (GeneStudio, Inc.). A PAUP command block was added manually in a text editor and nucleotide characters were left unweighted.

SEPAL v. 1.4 (Salisbury 2001) was used for a maximum-parsimony analysis [MP; 10 repeats searching for decay indices (Bremer 1994)]. SEPAL also performed 100 pseudoreplicates of MP jackknife character resampling (Efron & Gong 1983). PAUP* v. 4.0b8 (Swofford 2001) generated a Kimura 2-parameter (Kimura 1980) neighbor-joining dendrogram (NJ; Saitou & Nei 1987). In MP mode, PAUP* performed a single heuristic analysis (MAXTREES = 10.000, TBR swapping, ten simple-sequence addition replications with the NJ tree as starting tree). In addition, PAUP* generated 1.000 bootstrap pseudoreplicates (Felsenstein 1985; 50% majority rule, MAXTREES = 10.000, TBR swapping, ten random-sequence addition replicates, and two trees held at each step, branches of zero branch length allowed to collapse, steepest descent mode off).

Unique, shortest trees found in SEPAL, the PAUP* NJ tree, and the PAUP* MP bootstrap were combined into one NEXUS tree file using TreeView v. 1.6.1. (Page 1996). PAUP* compared support indices (CI, RI, RC, HI; ME-score under Kimura 2-parameter) for these trees, and evaluated them with maximum-likelihood [ML; Kishino-Hasegawa test (Kishino & Hasegawa 1989) with Hasegawa-Kishino-Yano model (Hasegawa et al. 1985); rates = gamma, shape = estimate, basefreq = empirical, assumed proportion of invariable sites = none].

The tested hypothesis was that different phylogenies estimated do NOT differ significantly. The tree indicated as best was selected for presentation, rooted with the agaric *Lepiota cristata* (see Krüger et al. 2001),

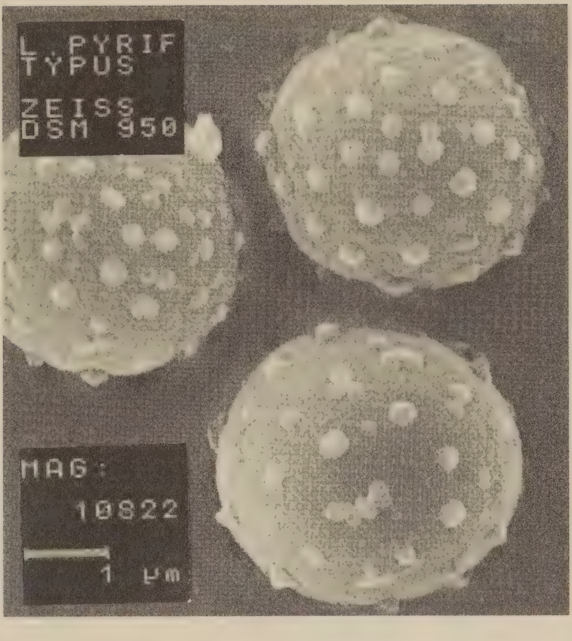

Figure 1. Scanning electron microscopy photograph of basidiospores of *Morganella pyriformis* epitype REG181091Os, magnification 10822X on Zeiss DSM 950. Scale bar indicates 1 µm.

and complemented by jackknife and decay values as branch support. Alignments are available at EMBL (ftp:// ftp.ebi.ac.uk/ pub/ databases/embl/align/; accessions: ALIGN_000359, shortened data set: ALIGN_000360).

RESULTS

Table 1 compares the indices and statistical tests for the seven trees generated with parsimony-informative sites. Tree 1, generated under the MP optimality criterion in SEPAL and selected by the KISHINO-HASEGAWA test as best based on length and likelihood, is shown in Fig. 2. Both the jackknife consensus and the bootstrap consensus were significantly worse. ML statistics did not reject the other two shortest MP decay analysis trees from SEPAL. Also not rejected were the PAUP*-generated NJ and single MP trees. The simple MP tree had been generated by swapping on the NJ tree, which improved length from 187 to 180 steps, producing an explanation almost as parsimonious as the best of the SEPAL trees. In the most-parsimonious of the compared trees, *Morganella fuliginea*, *M. subincarnata*, *L. pyriforme*, and TENN58935 are adjacent to each other, therefore providing support for emending *Morganella* to include *L. pyriforme.*

The specimens behind two GenBank sequences stemming from Terashima et al. (2002) are currently under review. The sequence assigned to *Lycoperdon pusillum* (Batsch: Pers.) Schumacher [= *Bovista pusilla* (Batsch: Pers.) Pers.] may represent *Bovista dermoxantha* (Vitt.) de Toni. The Japanese *Vascellum* (Terashima et al. 2002) may be *Vascellum curtisii* (Berk.) Kreisel. Morphology and sequence data together suggest the existence of a close ally of *L. pyriforme* in South America. There was only a slight sequence variation between the Paraguayan collection TENN58935 (AF485065) and the previously sequenced collections of *L. pyriforme.*

We propose a new subgenus in *Morganella* to accommodate *L. pyriforme* and designate as epitype a specimen from Schaeffer's original type

Table 1. Comparison of evaluated phylogenetic trees.

Program	SEPAL				PAUP*		
Criterion	MP				MP		NJ
	decay analyses, shortest trees in 10 analyses			half-deletion jackknife	bootstrap	single heuristic analysis	single analysis
Tree #	1	2	3	4	5	6	7
Length in MP	179	192	194	212	253	180	187
ME-score	4.83881	4.76046	4.61865	4.57764	5.14999	4.80617	4.10759
CI	0.542	0.505	0.500	0.458	0.383	0.539	0.519
RI	0.722	0.678	0.671	0.610	0.471	0.719	0.695
RC	0.391	0.343	0.336	0.279	0.181	0.387	0.360
HI	0.458	0.495	0.500	0.542	0.617	0.461	0.481
Kishino-Hasegawa Test (MP)							
_P_	_(best)_	_0.0012*_	_0.0021*_	_<0.0001*_	_<0.0001*_	_0.7654_	_0.0734_
Kishino-Hasegawa Test (ML)							
-ln L	791.290	801.579	800.118	825.908	889.836	794.762	796.879
T		1.9465	1.7315	2.8135	5.6152	0.5179	0.7318
_P_	_(best)_	_0.0557_	_0.0878_	_0.0064*_	_<0.0001*_	_0.6062_	_0.4668_

*Probability (_P_) of getting a more extreme T-value under the null hypothesis of no difference between the two trees (two-tailed test). Asterisked values in table (if any) indicate significant difference at $P < 0.05$.

ML = maximum-likelihood, MP = maximum-parsimony, NJ = neighbor-joining

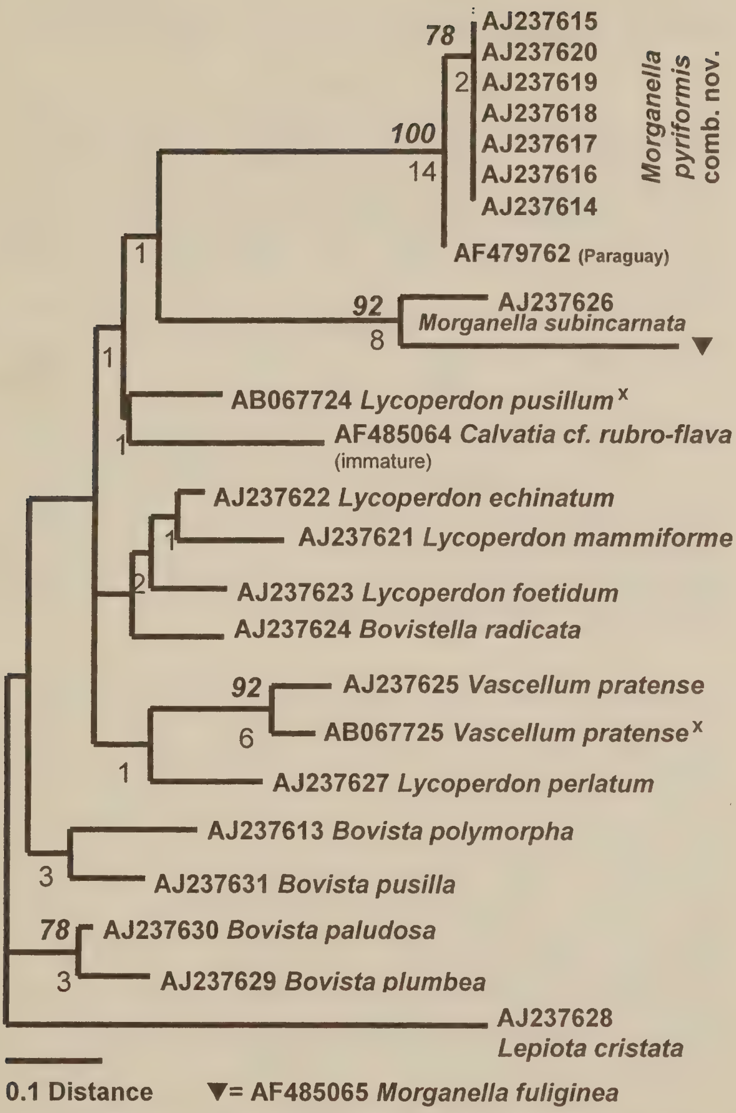
78
2
100
14
AJ237615
AJ237620
AJ237619
AJ237618
AJ237617
AJ237616
AJ237614
Morganella pyriformis comb. nov.
AF479762 (Paraguay)
1
92
8
AJ237626
Morganella subincarnata
▼
1
AB067724 Lycoperdon pusillum x
1
AF485064 Calvatia cf. rubro-flava (immature)
AJ237622 Lycoperdon echinatum
1
AJ237621 Lycoperdon mammiforme
2
AJ237623 Lycoperdon foetidum
AJ237624 Bovistella radicata
92
6
AJ237625 Vascellum pratense
AB067725 Vascellum pratense x
1
AJ237627 Lycoperdon perlatum
AJ237613 Bovista polymorpha
3
AJ237631 Bovista pusilla
78
3
AJ237630 Bovista paludosa
AJ237629 Bovista plumbea
AJ237628 Lepiota cristata
0.1 Distance
▼= AF485065 Morganella fuliginea

Figure 2. Phylogram of rDNA phylotypes of 23 gasteromycetes and one hymenomycete (*Lepiota cristata*) (parsimony-informative sites only). Rooted with *L. cristata*. SEPAL MP analysis. Half-deletion jackknife value above branches (where applicable and above 50), decay index below branches. 179 steps, CI = 0.542, RI = 0.722. ^{x} indicates disagreement in identification.

locality (vicinity of Regensburg in southern Germany). The sequence for the epitype has already been submitted to GenBank (KRÜGER et al. 2001).

TAXONOMY

Morganella subgenus Apioperdon KREISEL et D. KRÜGER, subgen. nov.

Subgenus generis *Morganella* ZELLER (Lycoperdaceae), generi *Lycoperdon* simile; ab eo differt habitu lignicolo, subgleba permanenter candida, capillitio non perforato, sphaerocytibus exoperidii protuberantiis digitaliformibus praeditis. *Morganella* subgenus *Morganella* differt capillitio copioso, exoperidio colore brunneo, coloribus violaceis vel rosaceis carente. Subgleba cellulosa. Typus subgeneris: *Lycoperdon pyriforme* SCHAEFFER 1774: PERS. 1801.

Etymology: *apion* (Gr.) = pear (referring to shape and the German name "Birnenstäubling"), *perdon* (Gr.) = wind (referring to *Lycoperdon*).

Apioperdon is proposed as a new subgenus in *Morganella*. It is similar to *Lycoperdon* but differs in its lignicolous habitat, and in having a true capillitium that is not pitted. It differs from the autonymous *Morganella* ZELLER subgen. *Morganella* in having a true capillitium, and from both *Lycoperdon* and *Morganella* subgen. *Morganella* by having a permanently white, distinctly cellular subgleba and an exoperidium covered with sphaerocytes provided with finger-like protuberances. The paracapillitium is abundant, and basidiomata are connected to the substrate by conspicuous white mycelial strands. The reader is also directed to SUÁREZ & WRIGHT (1996) for a complete description of *Morganella* subgen. *Morganella*.

We accept the genus *Morganella*, first proposed by ZELLER (1948) and later recircumscribed by KREISEL & DRING (1967) and PONCE DE LÉON (1971), but here emend it to include a new subgenus, *Apioperdon*, for puffballs characterized by true capillitium of the *Lycoperdon* type that are, however, unpitted (see KRÜGER et al. 2001). The uniting feature of *Morganella* becomes the usual growth on dead wood. In this aspect *Morganella* resembles *Bovista* PERS.: PERS. subgen. *Globaria* (QUÉLET) KREISEL section *Xyloperdon* KREISEL (KREISEL 1967). Section *Xyloperdon* puffballs are also lignicolous but grow on living trees, as opposed to *Morganella* species, which grow on dead wood. As discussed in RUNGE (1974) and BESL et al. (1982), the European collections of *Morganella subincarnata* (PECK) KREISEL & DRING were not lignicolous, but were found in peat bogs. Occasionally *L. pyriforme* apparently seems to grow on soil. The pinkish or violaceous tints frequently observed in the exoperidium of fresh specimens of *Morganella* subgen. *Morganella* species have never been observed in *Morganella pyriformis* where the exoperidium is brown in fresh and dried specimens, making the lack of these reddish colors another important character of subgen. *Apioperdon*. Both *Morganella* subgenus *Apioperdon* subgen. nov. and section *Subincarnata* PONCE DE LÉON of *Morganella* subgen. *Morganella* are characterized by a cellular subgleba. The terricolous genus *Vascellum* ŠMARDA also contains species with or without true capillitium (a paracapillitium is present; see KREISEL 1993).

The type species for the subgenus is *Lycoperdon pyriforme* SCHAEFF.: PERS., now *Morganella pyriformis*. The subgenus *Apioperdon* currently is monotypic.

Amended PONCE DE LÉON (1971) key to *Morganella* groups:

1. True capillitium of the *Lycoperdon* type and paracapillitium present -> Subgenus *Apioperdon*
1*. Only paracapillitium present in gleba - > Subgenus *Morganella* (2)
    2. Subgleba not chambered -> Section *Morganella*
    2*. Subgleba chambered -> Section *Subincarnata*

Morganella pyriformis (SCHAEFF.: PERS.) KREISEL et D. KRÜGER, comb. nov.

≡ *Lycoperdon pyriforme* SCHAEFF.: PERS.

(BASIONYM: JC SCHAEFFER, Fungorum Bavar Icones IV:128, 1774: PERSOON, Syn Meth Fung:148, 1801)

ICONOTYPUS: JC SCHAEFFER, Fungorum Bavar II:185, 1763 (Thurn und Taxis library in Regensburg).

LOCUS TYPI: Germania, circa Ratisbonam (Regensburg).

EPITYPUS (hic designatum): GERMANY. BAVARIA: County Kelheim (Niederbayern), Pentling-Hohengebraching near Regensburg, under *Picea* on wood, 18 Oct 1991, leg.: LINZENKIRCHNER, collection *Os97/91* (REG181091Os). GenBank sequence of ITS region rDNA: AJ237620. The selection of the epitype is based on the type locality and the morphological similarity to the specimens depicted in SCHAEFFER's plate.

Synonyms: see KREISEL (1962, 2001), DEMOULIN (1972).

Habitat: Caespitose on dead wood (logs, stumps, occasionally on woody debris) of broad-leaved and coniferous trees. The substrate spectrum in Europe includes a large number of hardwoods and conifer genera (only exceptionally *Pinus*; see KREISEL 1962, 1987). Sometimes apparently on soil.

Distribution: The species is near-cosmopolitan (PILÁT 1958, DEMOULIN 1972) with a primarily holarctic distribution in subarctic, boreal, and temperate zones of Eurasia and North America. It infrequently occurs in the Eurasian Mediterranean and other subtropical areas of Eurasia as well as in the countries of the Caribbean basin, Australia, and New Zealand. HERTER (in PILÁT 1958) suggested that the species may have been introduced to Uruguay. *Morganella pyriformis* is unknown from Africa; a record from Congo by DISSING & LANGE (1962) seems to be erroneous, for the description provided fits *Morganella* subgen. *Morganella*. The fungus has been found at surprisingly high elevations – 2.000 m in the Swiss Alps (FAVRE 1960), and at 4.000 m in the Himalayas of Nepal (KREISEL 1976).

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MYCOTAXON

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ANOTHER NEW BLUING SPECIES OF PSILOCYBE FROM GEORGIA, U.S.A.

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ABSTRACT

A new species of *Psilocybe* from Georgia is described as *P. atlantis*. The new species belongs to section *Mexicana*. Species in this section are typically hallucinogenic. This is the second species of *Psilocybe* reported from Georgia, only *P. weilii* (section *Cordispora*) was known previously from the state.

Keywords: Agaricales, Strophariaceae, hallucinogenic, fungi.

INTRODUCTION

Knowledge of the genus *Psilocybe* (Fr.) P. Kumm. in the United States is not yet complete, in spite of numerous studies (Singer and Smith, 1958; Guzmán, 1983, 1995, 2000; Guzmán *et al.*, 1997), as new species continue to be found. Some of the earliest studies of *Psilocybe* from the United States were by Peck (1872, 1897a,b; 1912), Atkinson (1909) and Murrill (1923), all of whom described several new species. At present there are 53 species of *Psilocybe* recognized from the United States.

Examination of a recent collection of *Psilocybe* from Georgia revealed that it differs in certain respects from previously described species (Guzmán, 1983, 1995, 2000), and it is described here as a new species.

MATERIALS AND METHODS

Freshly collected specimens were frozen, then preserved by dehydration in a Vir-Tis freeze dryer. Microscopic studies were made on rehydrated sections of the basidioma, mounted in 5% aqueous KOH. All basidiomata measurements were made on dried specimens. Colors of the basidioma are based on Wanscher and Kornerup (1991).

TAXONOMY

Psilocybe atlantis Guzmán, Hanlin et C. White Figs. 1-6

Pileus 26-38 mm latus in sicco, conicus-convexus, obtusus vel subumbonatus, leviter striatus, ferrugineus. Lamellae subadnatae, brunneolae. Stipes 40-45 x 2-4 mm in sicco, subbulbosus, rufus, fuscus vel cinereus, squamellulis albidis obtectus. Basidioma caerulescens. Sporae (8-) 9-10 (-11) x (5.5-) 6-6.5 (-7) x 5-5.5 (-6) µm, subrhombiformes a fronte visae, ellipsoide a latere visae, pariete crasso. Pleurocystidia (11-) 13-18 (-22) x (5.5-) 7-9 (-12) µm, hyalina, globoso-ventricosa, fusiformi-ventricosa vel sublageniformia. Cheilocystidia (17-) 20-34 (-43) x (5-) 6-9 (-11.5) µm, hyalina, ventricosa vel sublageniformia. Pileipellis ex strato subgelatinoso tenui hyphis prostatis constans. Subhymenium subcellulosum. Gregarius in terra graminea. Holotypus: USA, Georgia, prope Atlantam, October 3-4, 2000, C. White, XAL.

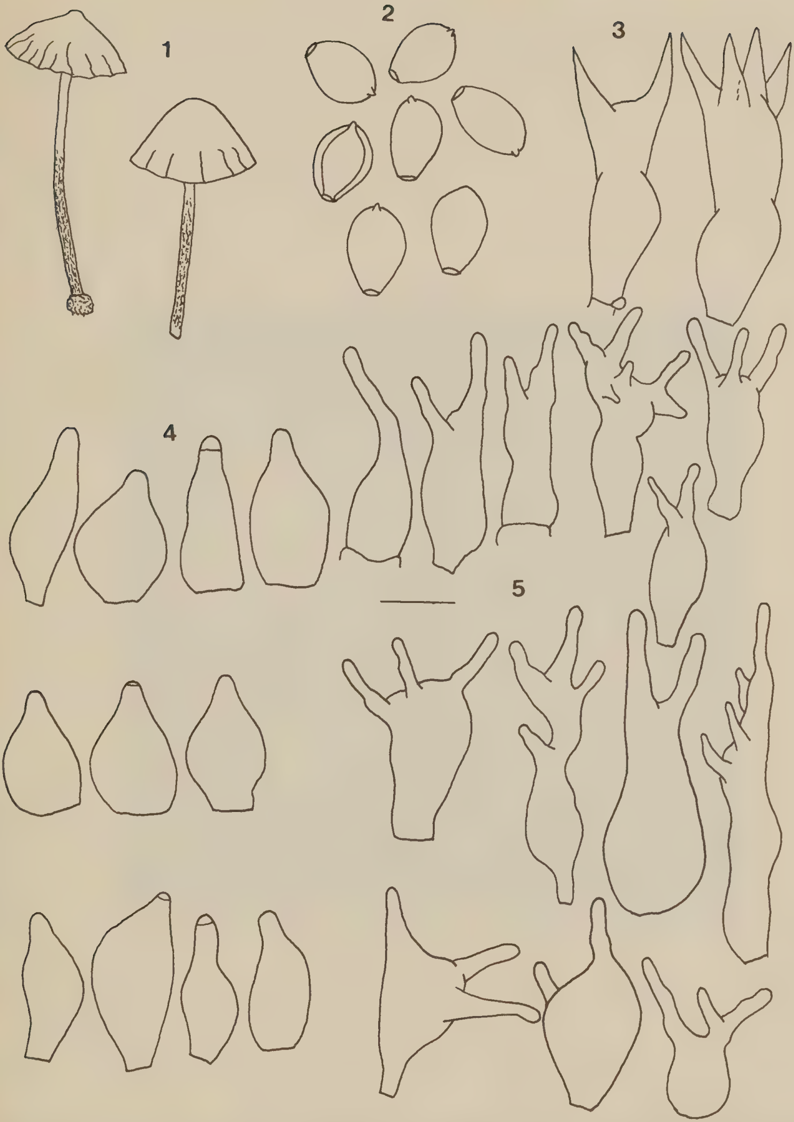
Pileus 26-38 mm diam (in dry specimens), conic-convex, obtuse or subumbonate, smooth to slightly striate, dry pale brown (6C4-5 or 6B4), with reddish hues (7D5-6). *Lamellae* subadnate, thin, brownish (6D5), finely mooted, edges concolorous. *Stipe* 40-45 x 2-4 mm (in dry specimens), equal, subbulbous, brownish red (6C6), grayish brown (6B3 or 6C3) or grayish (6B2), finely covered with small brownish scales, mainly toward the base. *Context* pale brownish (6B3) below the pileus, whitish above the lamellae and in the stipe. *Odor and taste* fungoid and pleasant. Bluing to 6DI or 6E1.

Basidiospores (8-) 9-10 (-11) x (5.5-) 6-6.5 (-7) x 5-5.5 (-6) µm, subrhomboid in face view, ellipsoid in side view, thick-walled (0.8-1 µm thick), yellowish brown, with a broad germ pore. *Basidia* (24-) 26-35 (-41) x 7.5-9.5 (-10) µm, 2-, 3- or 4-spored, but the more frequently 4-spored, sterigmata (2-) 3-4 µm long, hyaline, clavate-ventricose, with a median constriction. *Pleurocystidia* (11-) 13-18 (-22) x (5.5-) 7-9 (-12), µm, common, hyaline, some with yellowish brown incrustations toward the base, globose-ventricose, fusoid-ventricose or sublageniform with a short neck. *Cheilocystidia* (17-) 20-34 (-43) x (5-) 6-9 (-11.5) µm, common, hyaline, without incrustations, ventricose or sublageniform with a long neck, frequently with two or more necks or sometimes irregulary branched. *Gill trama* regular, formed by hyaline hyphae, narrow to subglobose, 2-32 µm wide, frequently with brownish incrustations. *Pileipellis* a thin ixocutis with postrate, 1.5-4 µm wide, hyaline or yellowish hyphae. *Subpellis* with inflated hyphae, 4-24 µm wide, hyaline, but with small, brownish incrustations. *Subbymenium* subcellular, with 3-12 µm wide elements, hyaline, but with small, brownish incrustations. *Clamp connections* common.

Habitat and distribution. Gregarious on soil, in a grassy lawn. Known only from the type locality.

Material examined. U.S.A., Georgia, Fulton Co., North of Atlanta, Aug. 7, 2000, *Lingchi* (communicated *White*) (Holotype XAL; Isotype GAM16047); Aug. 9, 2000, *White* (*Halling* A) (XAL); Aug. 10, 2000, *White* (*Halling* B) (XAL).

Etymology: Latin *atlantis*, for the type locality.



Figs. 1-5.- *Psilocybe atlantis.* 1: Basidiomata. 2: Basidiospores. 3: Basidia. 4: Pleurocystidia. 5: Cheilocystidia. All from the holotype. Scale bar = 8 µm, except in 1= 26 mm.

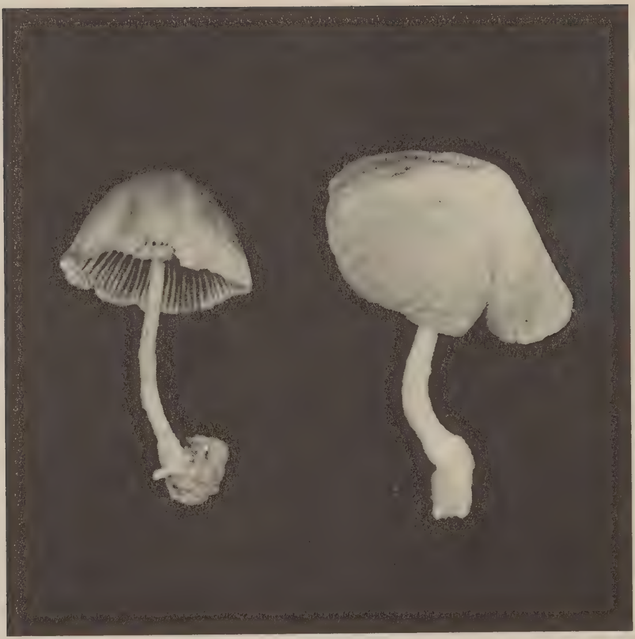


Fig. 6: *Psilocybe atlantis.* Natural size.

DISCUSSION

The long, subrhomboid basidiospores place this species in section *Mexicana* Guzmán, the species of which are typically hallucinogenic, following the classification of Guzmán (1983). On the basis of spore size, *P. atlantis* is close to *P. armandii* Guzmán & Pollock, *P. acutipilea* (Speg.) Guzmán, and *P. albofimbriata* Rick (= *P. farinacea* Rick ex Guzmán (following Guzmán, 1983, 1995), the former from Mexico and the others from Brazil. However, those species have no pleurocystidia and smaller cheilocystidia with little or no branching. *Psilocybe percystis* Singer also from Brazil (Singer, 1989) is another close species, but it differs by the absence of pleurocystidia.

This is the second species of *Psilocybe* to be reported from Georgia, the first report being by Guzmán *et al.* (1997), who described *P. weilii,* also from the Atlanta area.

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THE LICHEN FAMILY PHYSCIACEAE (ASCOMYCOTA) IN CHINA V. THE GENUS PHYSCONIA

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ABSTRACT: Nine species of the lichen genus *Physconia* from China's mainland are recognized. They are *Ph. chinensis*, *Ph. detersa*, *Ph. distorta*, *Ph. grumosa*, *Ph. hokkaidensis*, *Ph. kurokawae*, *Ph. leucoleiptes*, *Ph. lobulifera* and *Ph. muscigena*. Of these, *Ph. chinensis* is described as a new species, *Ph. hokkaidensis*, *Ph. kurokawae*, *Ph. leucoleiptes* and *Ph. lobulifera* are new to China. *Ph. venusta* should be excluded from the Chinese lichen flora. The previous reports of *Ph. enteroxantha* and *Ph. grisea* from China are uncertain.

KEYWORDS: *Physconia chinensis*, *Physconia hokkaidensis*, *Physconia kurokawae*, *Physconia lobulifera*

Introduction

Physconia, a foliose lichen genus, was established by Poelt (1965). By now, about nineteen species of *Physconia* have been known in the world (Moberg, 1977, 1994, Esslinger, 1994, 2000). In China, eight species of *Physconia* have been reported by Wei (1991). The results of the present studies show that the specimen reported as *Physconia venusta* (Ach.) Poelt (Tchou, 1935) is now identified as *Ph. distorta*. The occurrence of *Ph. enteroxantha* and *Ph. grisea* are still uncertain. *Ph. hokkaidensis*, *Ph. kurokawae* and *Ph. lobulifera* should be added to the Chinese lichen flora, and *Ph. chinensis* is new to science. *Ph. tentaculata* (Zahlbr.) Poelt distributed in Taiwan has not been found in China's mainland. At present, nine species of *Physconia* from China's mainland are recognized. All specimens studied are housed in HMAS-L and/or IFP. Lichen substances were detected by using the standardized thin-layer chromatographic methods of Culberson (1972). The terminology of the cortex tissues used by Moberg (1977) is followed in the present paper.

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Key to Physconia species in China's mainland

1. Thallus with soredia..2
1. Thallus without soredia...4
2. Gyrophoric acid present...*Ph. kurokawae*
2. Gyrophoric acid absent...3
3. Soralia labriform, K+ yellowish...*Ph. leucoleiptes*
3. Soralia marginal, K-..*Ph. detersa*
4. Isidia or lobules present 5
4. Isidia and lobules absent..8
5. Isidia present...*Ph. grumosa*
5. Lobules present...6
6. Gyrophoric acid present..*Ph. lobulifera*
6. Gyrophoric acid absent..7
7. Medulla yellow..*Ph. chinensis*
7. Medulla white ....*Ph. hokkaidensis*
8. Upper cortex paraplectenchymatous...*Ph. muscigena*
8. Upper cortex scleroplectenchymatous..*Ph. distorta*

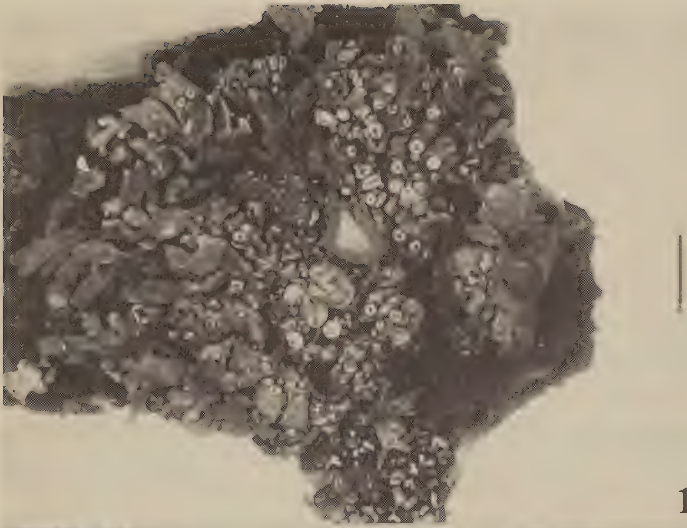
The Species

1. **Physconia chinensis** J. B. Chen et G. R. Hu, **sp. nov.** Figs.1-2

Physconia chinensis similis *Physconiae enteroxanthae* et *Physconiae hokkaidensi* ab illa cortice supero scleroplectenchymatico et lobulis ab hac medullis flavis differt.

Type: CHINA, Jilin, Jiaohe County, alt. 1000 m, on bark, Sept. 2, 1991, J. B. Chen & Y. M. Jiang 1448 (holotype in HMAS-L).

Thallus foliose, appressed to the substrate, 4-6 cm in diameter. Lobes irregularly branched, 0.5-1.5 (-2) mm broad, overlapping or separated; upper surface bright grey-brown, with whitish pruina. Lobules marginal and/or laminal, not ascending. Medulla pale yellow to yellow. Lower surface black, grey-white to brownish near the tips, rhizines black, dense and squarrosely branched, 1-2.5 mm long. Lobes 160-205 μm thick, upper cortex scleroplectenchymatous (Fig.2), 40-50μm thick, algal layer continuous, 35-45 μm thick, algal green, 6-9.5 μm in diameter; medulla 60-75 μm thick, lower cortex prosoplectenchymatous (hyphae more or less parallel to the surface of lobes), 25-35 μm thick. Apothecia common, 1-4 mm in diameter; disc with dense white pruina, margins entire or lobulate, hymenium hyaline, 115-132 μm, hypothecium 46-73 μm; asci clavate, 76-88×22-27 μm; spores *Physconia*-type, brown to dark brown, 22-32×12-17 μm.



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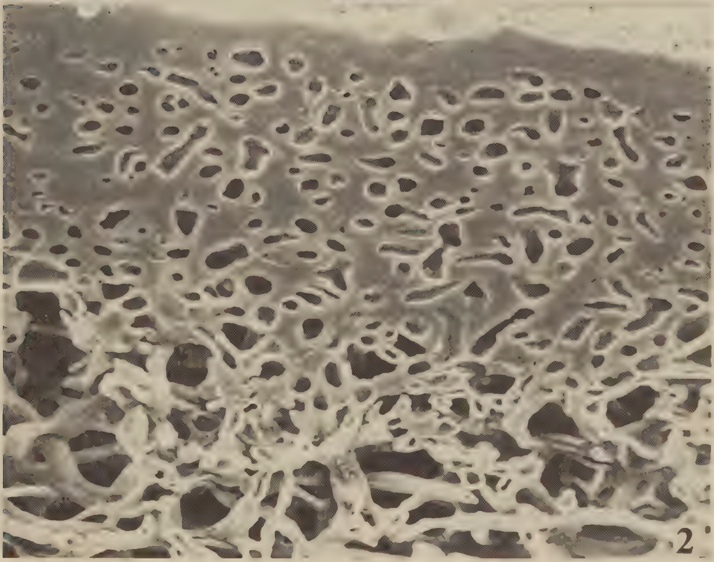

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Figs.1-2. *Physconia chinensis*: 1, Part of the holotype of *Ph. chinensis* (scale=5 mm); 2, Longitudinal section of lobe of the holotype of *Ph. chinensis* viewed with the scanning electron microscope, showing scleroplectenchymatous upper cortex (×800).

Chemistry: Thallus K-; medulla K+ yellow, C+ yellow, KC+ yellow to deep yellow, P-; containing a substance similar to secalonic acid A because it has the same colour and R_f value as the secalonic acid A does on TLC plate. However, the concentration of this substance in *Ph. chinesis* seems to be variable and often difficult to detect even by TLC for some of the paratype specimens.

The new species is characterized by the scleroplectenchymatous upper cortex, the marginal and laminal lobules, the yellow medulla, the spores of *Physconia*-type (22-32×12-17 μm), the dense, squarrosely branched rhizines and by the production of secalonic acid A.

Physconia chinensis is similar to *Ph. enteroxantha* in yellow medulla, but it differs from the latter by scleroplectenchymatous upper cortex and having lobules and lacking soredia. This new species resembles *Ph. hokkaidensis* in having lobules, but the medulla of *Ph. hokkaidensis* is white rather than yellow, and no lichen substances are found in *Ph. hokkaidensis*. This new species also resembles *Ph. distorta* in external appearances, however, *Ph. distorta* has white medulla, larger spores (27-38× 14-20 μm), wider lobes (up to 3.5 mm) and lacks lobules while *Ph. chinensis* has yellow medulla, smaller spores (22-32×12-17 μm), more narrow lobes (up to 2.0 mm broad) and has lobules. *Ph. chinensis* closely resembles *Ph. subpulverulenta* (Saztala) Poelt in both morphology and yellow medulla. However, the latter species is a Mediterranean element (Poelt 1965, Otte *et al.*, 2002) and lacks the laminar lobules of *Ph. chinensis*. Otte *et al.* (2002) pointed out that a *Physconia* specimen with yellow medulla collected in the Russian Far East probably belongs to an undescribed taxon. Although we haven't had the opportunity to observe this material, it probably belongs to *Ph. chinensis* rather than *Ph. subpulverulenta* based on ecology and geography.

This species is known only from China at present, and its distribution is shown in Fig. 3.

Paratype specimens: **Jilin**, Jiaohe County, J. B. Chen & Y. M. Jiang 1265; 1449; Helong County, C. F. Zhao & D. E. Gao 3872. **Liaoning**, Xinbin County, X. L. Chen *et al*. 5706. **Hubei**, Shenlongjia Distr. J. B. Chen 10068-1; 10119. **Yunnan**, Weixi County, J. J. Su 0806.

2. **Physconia detersa** (Nyl.) Poelt, Nova. Hedwigia **9**: 30 (1965).

This species is characterized by the marginal soralia, the white medulla, the black lower surface often with brown tips, and the absence of lichen substances. This species closely resembles *Ph. leucoleiptes*. However, *Ph. leucoleiptes* has labriform soralia which are marginal or terminal on lobes and K+ yellowish, while *Ph. detersa* has linear soralia which are marginal and K-.

This species from China has been reported by Jatta (1902), Zhao *et al.* (1982) and Chen *et al.* (1989) (see Wei, 1991). However, most Chinese specimens under the name *Physconia detersa* now belong to *Ph. leucoleiptes*, and true *Ph. detersa* is known only in Northeast China (see Fig.4).

Representative specimens examined: **Neimenggu**, Mt. A'er shan J. B. Chen & Y. M. Jiang A-887-5, Huzhong J. B. Chen & G. R. Hu 22041, 22051, 22063, 22080; **Jinlin**: Mt. Changbaishan J. C. Wei 2929-2.

3. **Physconia distorta** (With.) Laundon, Lichenologist **16**: 218 (1984).

This species is characterized by the brown lobes without soredia and isidia, the scleroplectenchymatous upper cortex, and the absence of lichen substances. It resembles *Ph. muscigena*, but the latter has ascending lobes, paraplectenchymatous upper cortex, and grows among mosses over rocks or on the ground.

All the records (see Wei, 1991) of *Physconia pulverulenta* in China refer to *Physconia distorta*. The distribution of *Ph. distorta* in China is shown in Fig. 4.

Representative specimens examined: **Neimenggu**, Balinyouqi, J. B. Chen & G. R. Hu 21431, 21432; Xinganmeng County, J. B. Chen & Y. M. Jiang 701,706. **Jilin**, Jiaohe, J. B. Chen & Y. M. Jiang 1058-1, 1264; Mt. Changbaishan, J. B. Chen & S. L. Wang 14035-1. **Beijing**, J. B. Chen 8544, 8631, Mt. Baihuashan L. W. Xu 8513. **Shaanxi**, Mt. Taibaishan, J. B. Chen & Q. He 5803, Q. M. Ma 36, 109b; Mt. Huashan, K. S.Hao 3960; Mt. Huanglongshan, K. T. Fu 3487. **Sichuan**, Jiuzhaigou, X. Y. Wang & X. Xiao 10116.

4. **Physconia grumosa** Kashiw. et Poelt, Ginkgoana **3**: 56 (1975).

This species is distinguished from other lobulate species of this genus by granular to subcylindrical isidia along the margins of lobes.

In China, this species has been reported only from Hubei province by Chen *et al.* (1982). It is now known in eight provinces of China (see Fig. 3).

Representative specimens examined: **Jilin**, Mt. Changbaishan, J. C. Wei 3005; J. B. Chen & S. L. Wang 14078, 14176; Jiaohe, J. B. Chen & Y. M. Jiang 983, 1435. **Neimenggu**, Balinyouqi County, J. B. Chen & G. R. Hu. 21381. **Hebei**, Mt. Wulingshan, J. B. Chen & S. L. Wang 115. **Shaanxi**, Mt. Taibeishan, J. B. Chen & Q. He 5856. **Hubei**, Shenlongjia, J. B. Chen 10134, 10527. **Anhui**, Yuexi County, M. R. Huang 639. **Sichuan**, Mt. Gongga, X. Y. Wang & X. Xiao 9159, 9387. **Yunnan**, Zhongdian County, X. Y. Wang 4335.

5. **Physconia hokkaidensis** Kashiw., Ginkgoana **3**: 57 (1975).

This species is characterized by the dorsiventral lobules along the margins of lobes, the white medulla, and the absence of lichen substances. *Ph. hokkaidensis* resembles

Ph. chinensis and *Ph. lobulifera* in having lobules. However, it can be clearly distinguished from the latter by chemical ingredients: *Ph. chinensis* has yellow pigment in the medulla, and *Ph. lobulifera* contains gyrophoric acid.

This species was originally described from Japan and has been considered to be endemic to Japan (Kashiwadani, 1975). However, the distribution of this species now extends to China where it has been collected from ten provinces (see Fig.3). New to China.

Representative specimens examined: **Heilongjiang**, Raohe, F. C. Zhao 966-2; Wuminhe, X. L. Chen 5353. **Jilin**, Mt. Changbaishan, J. B. Chen & S. L. Wang 14102, 14178; Jiaohe, J. B. Chen & Y. M. Jiang 1112, 1262-1, Wangqing County, J. C. Wei & Y. M. Jiang 59. **Liaonin**, Xinbin County, X. L. Chen et al. 5732-2. **Neimenggu**, Xinganmeng County, Mt. Aershan, J. B. Chen & Y. M. Jiang 452-1; Keyouqianqi, X. Q. Gao 934. **Xinjiang**, Mt. Tianshan, C. F. Zhao 2293. **Shaanxi**, Mt. Taibaishan, J. B. Chen & Q. He 6167. **Hubei**, Shenlongjia, J. B. Chen 10485, 11445. **Sichuan**, Wolong, X. Y. Wang & X. Xiao 10072. **Yunnan**, Weixi County, J. J. Su 612. **Xizang**, Chayu County, J. J. Su 4951.

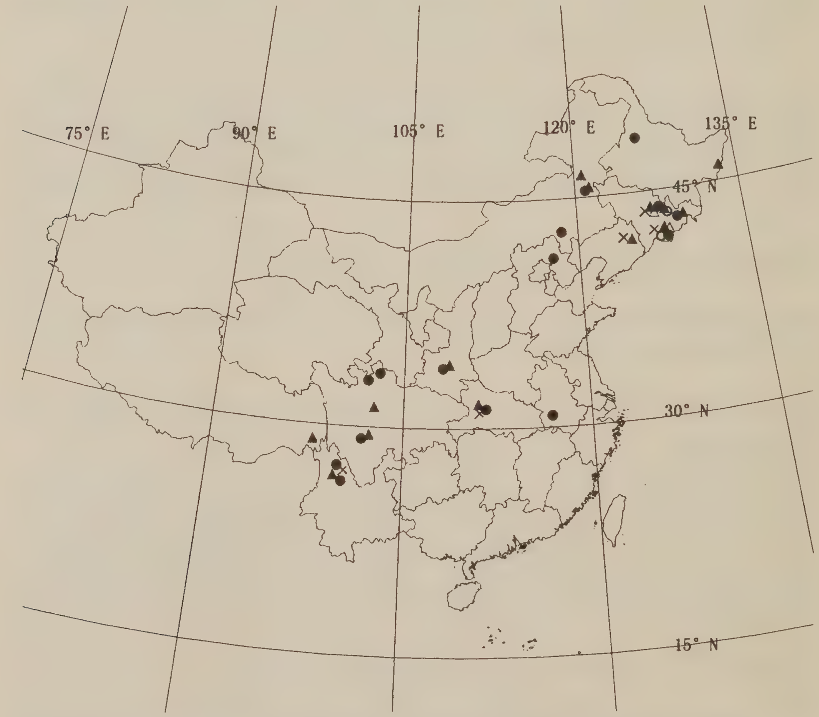

Fig.3. Chinese distribution of *Ph. chinensis* (×), *Ph. grumosa* (●), *Ph. hokkaidensis* (▲), *Ph. kurokawae* (△) and *Ph. lobulifera* (○).

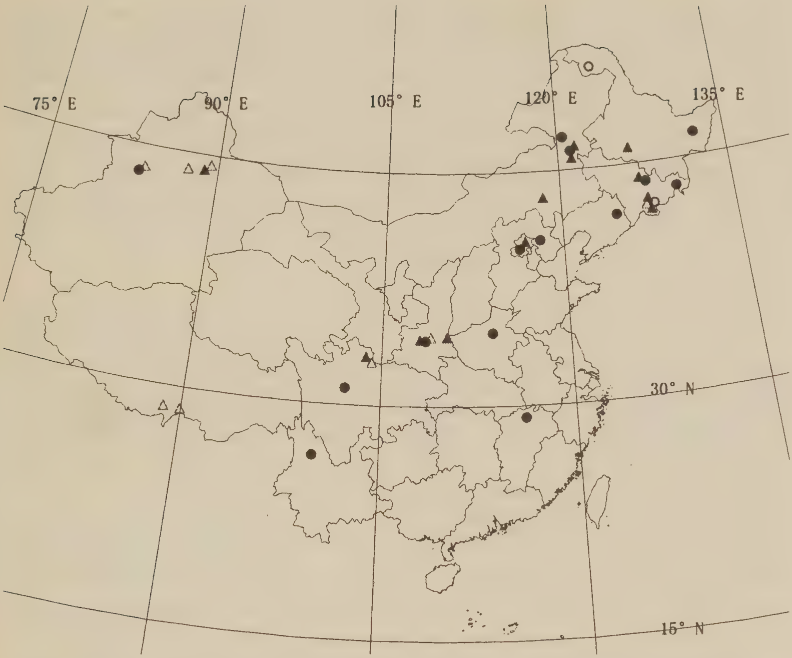

Fig.4. Chinese distribution of *Ph. detersa* (○), *Ph. distorta* (▲), *Ph. leucoleiptes* (●) and *Ph. muscigena* (△). *A few of localities recorded in literature are not shown in Fig.4, because the authors have not seen the related specimens.

6. **Physconia kurokawae** Kashiw., Ginkgoana **3**: 58 (1975).

The most distinctive characteristics of this species are the form of the soralia and its chemistry. The soralia are marginal and terminal on lobes, and become labriform when the lobe tip or margin becomes reflexed. Moreover, this species contains gyrophoric acid in the medulla. This species is closely related to *Ph. leucoleiptes* because they have similar lobes with labriform soralia. However, it is easily distinguished from the latter by the presence of gyrophoric acid. The distribution in China of this species is shown in Fig. 3. New to China.

Representative specimens examined: **Jinlin**, Jiaohe, J. B. Chen & Y. M. Jiang 998, 1014, 1058, 1092; Mt. Changbaishan, X. D. Lu 486, 837-1.

7. **Physconia leucoleiptes** (Tuck.) Essl. Mycotaxon **51**: 91-99 (1994)
≡ *Parmelia pulverulenta β leocoleiptes* Tuck., Proceedings of the American Academy of Arts and Sciences 1: 224 (1847).
=*Physcia leucoleiptes* (Tuck.) Lettau, Hedwigia 7: 254 (1912).

The most distinctive characteristics of this species are the form of the soralia and the reaction with K reagent. The soralia are marginal or terminal, and become labriform as the lobe tip or margin becomes upturned. Moreover, the soralia are usually white and K+ dingy yellowish and stronger KC+ yellow-orange. *Ph. leucoleiptes* closely resembles the *Ph. detersa* and *Ph. kurokawae* in morphology. However, the marginal or terminal soralia of *Ph. leucoleiptes* are rather strongly labriform and K+ yellow, while the soralia of *Ph. detersa* are linear on lobes margin and K-. Comparing with *Ph. kurokawae*, *Ph. leucoleiptes* does not contain gyrophoric acid. The distribution of this species is shown in Fig.4. New to China.

Representative specimens examined: **Heilongjiang**, Baoqing County, C. F. Zhao 689; Mt. Daxinganling, X. L. Chen 3322. **Jilin**, Jiaohe J. B. Chen & Y. M. Jiang 985, 1003. **Liaonin**, Xinbin County, X. L. Chen *et al*. 5566. **Xinjiang**, Mt. Tianshan, C. F. Zhao 2594-1. **Shaanxi**, Mt. Taibaishan, J. B. Chen & Q. He 6657, Q. M. Ma 402. **Beijing**, Mt. Baihuashan, J. C. Wei 3419, Zhao *et al*. 6442. **Heibei**, Mt. Wulingshan, K. S. Hao 2139. **Heinan**: K. M. Liou 4564. **Jiangxi**, Mt. Lushan, J. D. Zhao 422. **Sichuan**, Wolong J. B. Chen 6293. **Yunnan,** Lijiang County Y. M. Jiang 365.

8. **Physconia lobulifera** Kashiw., Ginkgoana **3**: 60 (1975).

This species is closely related to *Ph. hokkaidensis* because they have similar lobulate lobes and white medulla. However, it is separated from *Ph. hokkaidensis* by the presence of gyrophoric acid. This species has been known only from Japan, but its distribution now extends to Jinlin province of China (see Fig. 3). New to China.

Specimens examined: **Jinlin**, Mt. Changbaishan, X. Q. Gao 3311; Dunhua County, C. F. Zhao & D. E. Gao 4156.

9. **Physconia muscigena** (Ach.) Poelt, Nova. Hedwigia 9: 30 (1965).

This species is characterized by the brown and ascending lobes with dense pruina, the paraplectenchymatous upper cortex, the white medulla, the absence of asexual propagules, the absence of lichen substances, and the muscicolous or saxicolous habits. *Ph. muscigena* resembles *Ph. distorta* morphologically and chemically, but *Ph. distorta* has a scleroplectenchymatous upper cortex and often grows on bark.

This species was reported from China by Jatta (1902), Zahlbruckner (1930), Zhao *et al* (1982), and Wei & Chen (1974) (see Wei, 1991). Its Chinese distribution is shown in Fig.4.

Representative specimens examined: **Jilin**, Mt. Changbaishan, J. C. Wei 2968. **Xinjiang**, Mt. Tianshan, C. F. Zhao 2308, 2340, 2462. **Shaanxi**, Mt. Taibaishan, J. B. Chen & Q. He 6013. **Sichuan**, Mt. Balangshan, X. Y. Wang *et al*. 9553, 9842. **Xizang**: Nielamu County J. C. Wei & J. B. Chen 1895-3, Mt. Everest J. C. Wei & J. B. Chen 1252, 1254.

Excluded Species

Physconia venusta (Ach.) Poelt

This species from China was only reported by Tchou (1935) based on a single specimen (K. S. Hao 3960). The specimen has been reidentified as *Ph. distorta*. In addition, *Ph. venusta* is a European species, while *Ph. distorta* is widely distributed in eastern Asia and Europe.

Uncertain Species

Physconia grisea (Lam.) Poelt

A total of 12 specimens under the name of *Physcia farrea* (=*Ph.grisea*) and *Physcia grisea* from 4 provinces of China reported by Zhao *et al.* (1982) have been reidentified as *Physconia leucoleiptes*. One specimen under the name of *Physconia grisea* from Hubei province reported by Chen *et al.* (1989) does not belong to the genus *Physconia*. We can not trace other specimens of this species from China reported by Jatta (1902), A. Zahlbruckner (1930), Tchou (1935) and Moreau et Moreau (1951) (see Wei, 1991).

Physconia enteroxantha (Nyl.) Poelt

In China, this species was only reported by Zhao *et al.* (1982) based on one specimen from Zhejiang province. Unfortunately, we have not found the specimen or other specimens of this species.

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A NEW MICROCOLONIAL ROCK-INHABITING FUNGUS FROM MARBLE IN CHERSONESOS (CRIMEA, UKRAINE)

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ABSTRACT

Phaeococcomyces chersonesos sp.nov., repeatedly isolated from marble at Chersonesos archaeological site, is described, illustrated and discussed.

Key words: black yeast, lithobiont.

Introduction

Research on microcolonial rock-inhabiting fungi over the last 20 years in various laboratories worldwide has established two important facts. The first is that these organisms form a well-defined group, possessing certain particular features, such as very plastic morphology, high melanization, meristematic growth, and some dimorphism (Staley *et al.*, 1982; Wollenzien *et al.*, 1995; Sterflinger & Krumbein, 1997; Sterflinger *et al.*, 1997). The second is that this group, which is ecological rather than taxonomic, is likely to contain many new species and, possibly, genera which await description.

Modern molecular approaches are very useful for this work; but results can be controversial (Sterflinger & Gorbushina, 1997; Wollenzien *et al.*, 1997). Interest in this group of fungi is also driven by their potential importance as agents of stone biodeterioration, particularly of archaeological and museum marble and limestone which can be actively colonised and spoiled (Krumbein & Jens 1981; Staley *et al.*, 1982; Palmer *et al.*, 1987; Wollenzien *et al.*, 1995, 1997; Sterflinger & Krumbein, 1997; Sterflinger *et al.*, 1997; Sterflinger & Gorbushina, 1997). Some newly described rock-inhabiting species have never been found on any other substrata (Wollenzien *et al.*, 1997); others, including species of *Aureobasidium* Viala & G.

Boyer, *Exophiala* J.W. Carmich., *Phialophora* Medlar and *Sarcinomyces* Lindner, are known as opportunistic human pathogens (de Hoog, 1993), giving them an additional importance.

During the senior author's work since 1993 on rock-inhabiting microcolonial fungi from marble at Chersonesos archaeological site and museum (Crimea, Ukraine), a fungus was repeatedly isolated which could not be allocated to any known species. The objective of the present paper is to describe and discuss that fungus.

Material and methods

Isolation

Between 1993 and 2001 samples were taken of various marble monuments from within the grounds of the Chersonesos archaeological site (Crimea, Ukraine). Fungi were isolated direct from the marble surface using a sterile syringe needle, or by inoculation of agar plates with small marble particles. Isolation media were: tap water agar with the addition of streptomycin (to avoid bacterial growth); DRBC medium containing dichloran (2 mg/l), rose bengal (25 mg/l) and chloramphenicol (0.2 g/l); diluted Czapek agar; diluted PDA (potato dextrose agar). Criteria for detecting fungal presence on the marble were: black dots or spots on the rock surface, black cracks, and detaching scales of rock.

Pure cultures were maintained on OA (oat meal agar), PDA, Czapeck-Dox agar, or 2% malt extract agar with subculturing every 6 months. The collection of strains is maintained in, and remains the property of the Laboratory of General Biophysics, Biology and Soil Sciences Faculty, St.Petersburg State University, St.Petersburg, Russia. Strains numbers are: Ch 12, Ch 20, Ch 21, Ch 49, Ch 56, Ch 59, Ch 61, Ch 62, Ch 63. Strain number Ch 49 is also deposited in the CABI Bioscience Culture Collection as number **IMI** 389175.

Physiology

Physiological growth patterns of strain Ch 49 were tested at CABI Bioscience, using the ID 32 C identification system for yeasts (bioMerieux, France) and YT MicroPlate test panels (Biolog, Hayward, CA, USA), in triplicate. Results were evaluated after 3 weeks of incubation.

Scanning Electron Microscopy

Several marble samples from which strains were isolated were examined using scanning electron microscopy. For this analysis small marble particles were fixed in 4% glutaraldehyde and 1% OsO_4 in a 0.1M cacodylate buffer (pH 7.4) at 4˚C, washed in cacodylate buffer, then dehydrated in an ethanol series: 15% (15 min), 30% (15 min), 50% (30 min), 70% (over night), 80% (60 min), 90% (60 min) and 100% (60 min) and critical-point dried. Samples were then mounted, covered with gold, and studied using the CABI Bioscience Hitachi S-570 scanning electron microscope.

Results

Description

Colonies occurring naturally on rock. Appearing as small black dots or minute points of black material when viewed by the unaided eye, less on flat exposed

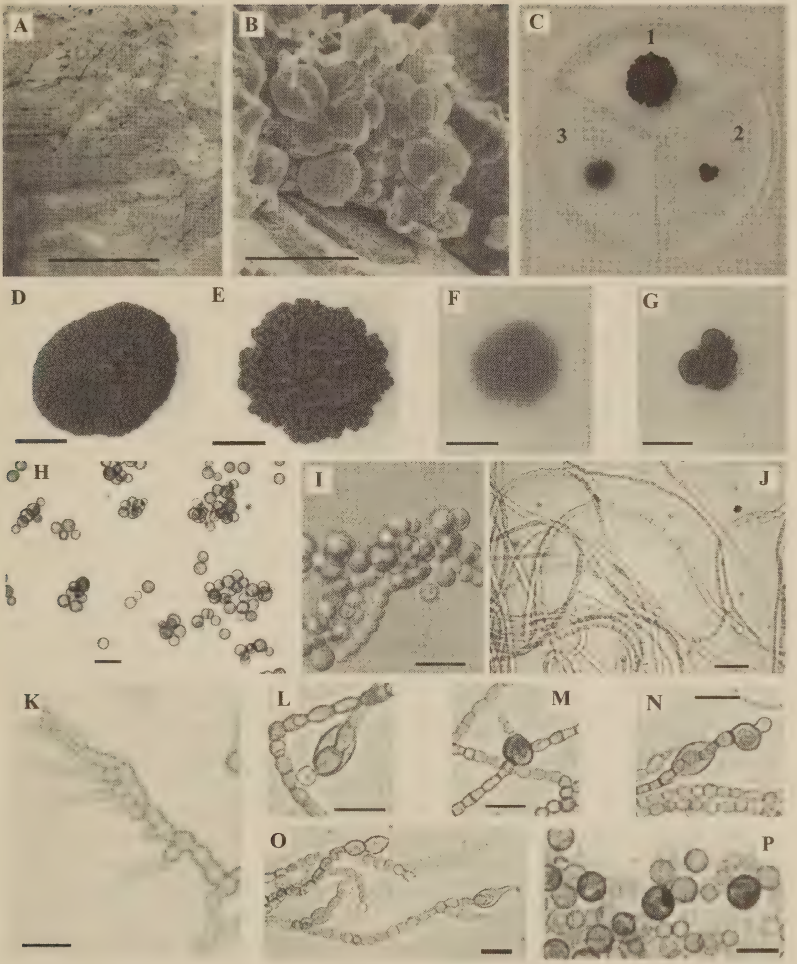

Fig. 1. A. View of marble with fungal microcolonies inside the cracks (bar = 1 mm). **B**. SEM micrograph of native colony of *Ph. chersonesos* on the surface of marble (bar = 10 μm). **C**. Petri dish with 1-month-old cultures of *Ph. chersonesos* on (1) Sabouraud's glucose agar, (2) Czapek agar, (3) oat meal agar. **D** & **E**. Granular and cerebriform one-month-old colonies on Sabouraud's glucose agar (bar = 1 cm). **F**. One-month-old colony with good developed immersed mycelium on oat meal agar (bar = 1 cm). **G**. One-month-old colony of rather restricted diameter showing both yeast-like (pasty) and mycelial development (bar = 1 cm). **H**. Yeast-like growth form (bar = 10 μm). **I**. Yeast-like cells (note chain of undetached cells) (bar = 10 μm). **J.** Mycelial growth form (bar = 10 μm). **K**. Lateral branching and budding of mycelium (bar = 10 μm). **L-O**. Examples of internally proliferating thick-walled cells in old culture (bar = 10 μm). **P**. Thick-walled spherical cells, formed in old culture from yeast-like cells (bar = 10 μm).

surfaces and more filling small surface cracks and holes (Fig. 1, A); typically black, more or less globose but slightly rugose and composed of spherical cells in tight clusters when viewed with a stereo microscope; similar when viewed with the SEM, showing clusters of spherical yeast-like cells located inside rock crystals, or holes, cracks and indentations of the rock surface. Individual cells sometimes appearing smooth and clean (in which case they looked young), but more usually covered by a rough crust (in which case they looked older, and the covering looked like an inorganic deposit, perhaps from crystalization of salts). A typical microcolony, composed mostly of smooth cells, is shown in Fig. 1, B. In some cases, the shape of the rock hole occupied by a colony can look as though it was made by fungal colony itself.

Colonies in pure culture. The main growth forms, as observed in experimental conditions, are shown in Fig. 2. Small, attaining up to 10 mm diameter in 4 weeks, sometimes punctiform, olivaceous-black when young, later black, initially glistening, moist, buttery, later becoming dry and hard, wrinkled or cerebriform, sometimes with slight grey aerial mycelium and deeply immersed mycelium, with a sharp margin; young colonies consisting of yeast-like cells; older colonies usually with cylindrical mycelium ("true mycelium") which may be aerial and/or immersed in agar, and usually also with non-cylindrical mycelium (moniliform mycelium) and thick-walled spores ("chlamydospores"); on oatmeal agar punctiform, with aerial mycelium appearing early; on potato dextrose agar glistening, pasty, smooth; on Sabouraud's glucose agar wrinkled or cerebriform, elevated, glistening; on malt extract agar pasty, glistening, smooth: no significant pigment excretion has been found on PDA, OA, MEA, CzA, Sabouraud's glucose agar, water agar, YEA, or glucose agar. **Mycelium**. Of two types: the first, moniliform mycelium, comprising chains of pigmented yeast-like cells, usually constricted at septa; the second, "true mycelium", usually originating from moniliform mycelium by gradual change, more or less branched (depending on culture medium), septate, pigmented, composed of cells 7.8–10.2 × 2.3–2.7 μm, sometimes producing lateral yeast-like growth (Fig. 1, K). **Stromata**. Not observed. **Conidiophores**. Not observed. **Conidiogenous cells**. Older yeast-like or mycelial cells, almost colourless to dark, spherical, 4.5–5.5 μm diam (average size varying slightly between strains) producing multilaterally 1–3 (–5) spherical daughter cells, sometimes forming chains and gradually converting to moniliform mycelium and/or "true mycelium". **Thick-walled spores** ("chlamydospores"). Formed in older colonies or in extreme culture conditions, e.g. after addition of heavy metal salts ($CuSO_4$, $MnSO_4$, $ZnSO_4$) to the culture media; usually originating from yeast-like cells, but sometimes formed from "true mycelium" or moniliform mycelium, intercalary or terminal, 6.1–8.5 μm diam., mostly one-celled, but sometimes with 1-2 transverse or oblique septa, dark, black or blackish-brown, rarely proliferating by moniliform hyphae or yeast-like growth. **Conidia**. Almost colourless, spherical, forming multilaterally on "true mycelium", moniliform mycelium or yeast-like cells.

Physiological features

Results of the physiological study of strain Ch 49 are shown in Table 1. For comparison, information about certain other black yeasts, taken from the literature, has also been placed in the table. In the table only information about assimilation of substances tested for most species is shown. An empty cell means "no data". The letter "w" means "weak or slow" growth; "+" before and combined with "w" means

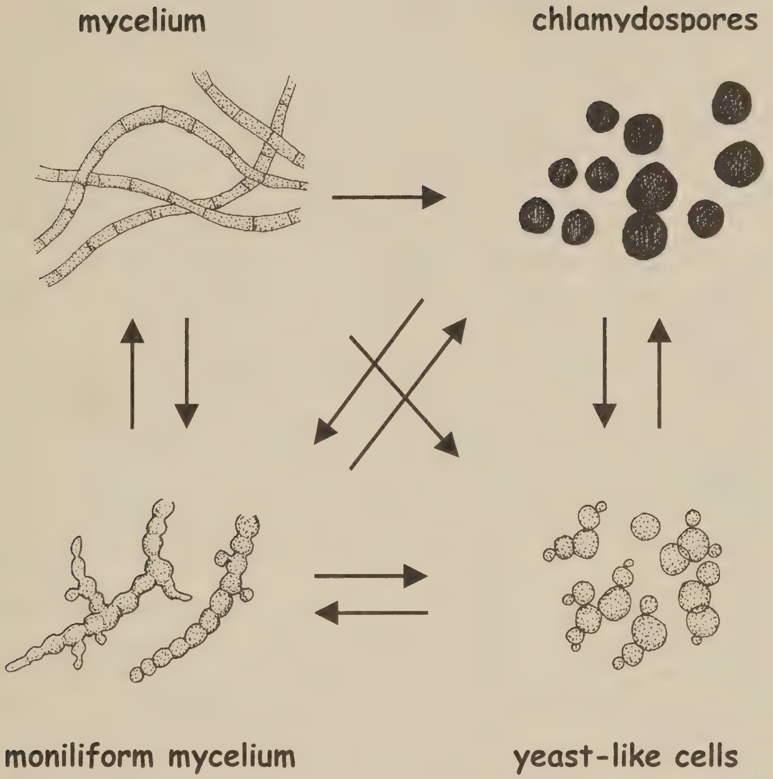

Fig. 2. Scheme of the main transitions between growth forms of *Ph. chersonesos*. Arrows indicate direction of morphological conversions.

"normal to weak" growth; "+" after and combined with "w" means "weak to normal" growth; "-" before and combined with "w" means "practically absent (extremely weak) to weak" growth; "-" after and combined with "w" means "weak or absent" growth. When relating our work with that published by others, differences were scored between unambiguous results (for example between "+" and "-"), or between one unambiguous result and an ambiguous result tending to be opposite (for example between "+" and "w/-"), or between two ambiguous results tending to be opposite (for example between "w/+" and "w/-"). Differences between other ambiguous results (for example between "w" and "w/+", or "w/-" and "-/w", "+/w") were ignored.

Table 1. Physiological profiles of some black meristematic fungi and yeasts (de Hoog *et al.*,1995, 1997; de Hoog & Gerrits van den Ende, 1992; Butin *et al.*, 1996; Wollenzien *et al.*,1997).

	Present fungus, strain Ch 49 (3 weeks)	Sarcinomyces petricola	Phaeococcomyces exophialae	Phaeotheca fissurella	Phaeotheca triangularis	Hortaea werneckii
Cellobiose	+	+	+	+	+	+
D-arabinose	+	+	+	-	+	+/w
D-galactose	+/w	+	+	+	+	+
D-glucose	+	+	+	+	+	+
D-ribose	+/w	+	+	w	+	w/+
D-xylose	+	+	+	+	+	+
Lactose	+/w	-	w	+	+	+
L-arabinose	+	+	+		+	+
L-rhamnose	+/w	-/w	+	-	+	+/w
L-sorbose	+	+	+		+	+
Maltose	+	+	+	+	+	+
Melezitose	+	+	+	+	+	+
Melibiose	+	+	+	+	+	+
Raffinose	+	+	+	+	+	+
Sucrose	+	+	+	+	+	+
Trehalose	+	+	+	+	+	+
2-keto-D-gluconate	w	w/-				
Citrate	+	-	+	-	-	w/-
D-glucuronate	+/w	+	+			
DL-lactate	+/w	-	+	+	+	-
Gluconate	+/w	+	+	-	+	w
Methyl succinate	+/w	+/w	+	-	+	w/+
Arbutin	+	-		-	-	+
Inulin	w/+	+/w	w	-	w	-/w
Salicin	+/w	w/-		+	w/-	w/+
D-glucosamine	w/-	-			-	w/-
D-mannitol	+	+	+	+	+	+
Erythritol	+/w	+	+	-	+	+
Ethanol	w	+	w	-	+	w
Glycerol	+	+	+	+	+	+
Inositol	+	+/w	+	-	-	+
Methanol	-	-	-	-	-	-
Xylitol	+	+	+	-	+	w/-
α-methyl-D-glucoside	+/w	+/w/-		-	+	w/-
Nitrate	+	+	+	+	+	+
5-10% $MgCl_2$	+	+	+	+	+	+
5% NaCl	+	+	+	-	+	+
10% NaCl	w	+/w/-	w	-	+	+
Cycloheximide 0.01-0.1%	-	-	+	-	-	-
Urease	+	+	+	+	-	+/w
Fermentation	-	-	-	-	-	-
Growth at 30° C	w	+	+	+	-	+
Growth at 37° C	-	-	+	w	-	-/w
Growth at 40° C	-	-	-	w	-	-
Acid production	-	-				-

Discussion

Development and Morphology

Slight variations were observed between strains examined in the present study in cell size (variation never greater than 1 μm) and intensity of pigmentation (Ch 12 was the darkest, Ch 59 the least). Results of a detailed morphometrical analysis of the strains were published by Bogomolova (2000). The general similarity of all strains and the uniformity of sources from which they were isolated suggest that all belong to a single species. That species, the present fungus, is clearly a "black yeast", belonging somewhere in the region of *Sarcinomyces* or *Phaeococcomyces* de Hoog.

In many respects, the development and morphology of the present fungus is similar to species of *Sarcinomyces*. Of the five species known to exist in this genus [*S. albus* Lindner, *S. crustaceus* Lindner, *S. inkin* Oho, *S. petricola* Wollenz. & de Hoog and *S. phaeomuriformis* T. Matsumoto, A.A. Padhye, Ajello & McGinnis] it is closest to *S. petricola*. Developmental and morphological similarities between the present fungus and other meristematic black yeasts are limited. There is, furthermore, no strong morphological similarity with other rock-inhabiting fungi which have black meristematic growth. The present fungus does, however, also fit rather closely in the genus *Phaeococcomyces* de Hoog. Of the four species known to exist in that genus [*P. alcalophilus* Goto & Sugiy., *P. catenatus* (de Hoog & Herm.-Nijh.) de Hoog, *P. exophialae* (de Hoog) de Hoog and *P. nigricans* (M.A. Rich. & A.M. Stern) de Hoog], it is closest to *P. exophialae*.

Physiological Information

In terms of physiology (Table 1), the present fungus has features distinct from all of the other species in the table, but most of all from *Phaeotheca fissurella* Sigler, Tsuneda & J.W. Carmich., with differences in about 12 positions within the table. *Phaeotheca fissurella* and *P. triangularis* de Hoog & Beguin show some differences in physiological patterns between two species of the same genus. *Hortaea werneckii* (Horta) Nishim. & Miyaji can be viewed as a reference point to show the sort of differences which can exist in a species from a very different genus. Although the picture is not clear, *S. petricola* and *P. exophialae* are perhaps closest to the present fungus. Differences between the present fungus and *S. petricola* occur at about 6 positions in the table; differences between *S. petricola* and *P. exophialae* occur at about 5 positions (information about 6 tests is unavailable for *P. exophialae*); the difference between the present fungus and *P. exophialae* is about 2-3 positions (information about 6 tests is unavailable for *P. exophialae*). In general, these 3 species look equally close to each other. Each is, however, clearly separate.

Comparison of Present Fungus with P. exophialae *and* S. petricola

The original circumscription of the genus *Phaeococcomyces* did not include mycelial growth (de Hoog & Hermanides-Nijhof, 1977); the present fungus differs from all described species of *Phaeococcomyces* in having mycelium (Fig. 2, J, K), and differs in particular from *P. exophialae* in the shape and size of individual cells. Mycelial growth in the present fungus was most marked on certain culture media (e.g. oat extract, PDA). This contrasts with *S. petricola*, where mycelial growth is very limited. Hyphae are thinner and with shorter cells in the present fungus than those described for *S. petricola* (2-3 × 7-10 µm and 5 × 10 µm respectively). The present fungus has long, sometimes branching mycelium with pale thin-walled cells, whereas in *S. petricola* branching is not significant and hyphae are thicker walled, and dark or blackish brown). In the present fungus, hyphae never disarticulate into individual cells as they do in *S. petricola*. The present fungus also lacks an obvious meristematic growth (which, in species where it occurs, is usually marked by multiple longitudinal, oblique and transverse septation), and no bursting of the outer cell wall layer is observed in older cells (as occurs in meristematic growth of *S. petricola*). In pure culture, particularly on Sabouraud's glucose agar and 2% malt extract agar, the present fungus excretes no pigment into the medium, a feature observed in *S. petricola*. Finally, on PDA, the colony shape of the present fungus differs from that of *S. petricola*.

Generic placement of S. petricola

The placement of *S. petricola* within the genus *Sarcinomyces* is not completely satisfactory. When they first described *S. petricola*, Wollenzien *et al.* (1997) noted that, “the spectrum of SSU restriction patterns of *S. petricola* obtained differed consistently from that of the remaining species” [type strains of *Aureobasidium pullulans* (de Bary) Arnaud, *Botryomyces* de Hoog & C. Rubio, *Exophiala jeanselmei*, *Phaeococcomyces*, *Phaeosclera* Sigler, Tsuneda & J.W. Carmich., *Phaeotheca* Sigler, Tsuneda & J.W. Carmich., *Sarcinomyces* and *Trimmatostroma* Corda] “including the morphologically most similar species, *S. phaeomuriformis*”. The controversial character of the morphological and molecular data led those authors to classify their strain in the oldest genus of anamorphic ‘meristematic’ fungi available: *Sarcinomyces* Lindner. They indicated that *S. petricola* was morphologically similar to yeast-like synanamorphs of *Exophiala* and to *Phaeococcomyces*, but noted that comparison of many physiological parameters with those published by de Hoog *et al.* (1995) revealed many differences between *S. petricola* and *P. nigricans*, type of its genus. Wollenzien *et al.* (1997) further noted that restriction patterns of *S. petricola* differed from those of the morphologically close species *S. phaeomuriformis*, as did physiological parameters (including the inability of *S. petricola* to grow at 40˚C).

Molecular Information

An unpublished molecular study (partial 18S rRNA gene, 5.8S rRNA gene, partial 28S rRNA gene, ITS1 and ITS2) on strain Ch 49 (O.V. Vasilenko, National Hematology Research Centre of the Russian Academy of Medical Sciences, Moscow, Russia, pers. comm.) shows high similarity of the present fungus with *S. petricola* (compared to Genbank data), less similarity with species of *Phaeococcomyces* (in particular, with *P. catenatus*), and considerably less similarity with *Exophiala dermatitidis* (Kano) de Hoog and *E. jeanselmei* (Langer) McGinnis & A.A. Padhye. Even brief analysis of molecular data, presented in Genbank, shows that *S. petricola* and the present fungus are close to each other and rather distant from other species of meristematic black yeasts, including other species of *Sarcinomyces*.

Conclusion

The absence of clear meristematic growth makes it inappropriate to classify the present fungus in the genus *Sarcinomyces*. The only purely morphological similarity the present fungus has is with members of the genus *Phaeococcomyces*. Even that, however, is not totally satisfactory, as the present fungus also has a mycelial phase. There are, however, certain morphological, molecular and physiological similarities with *S. petricola*. It may be significant that *S. petricola* and the present species both seem to be marked lithobionts: neither has been found on any substratum other than stone (Wollenzien *et al.*, 1997). This suggests that erection of a new genus, based on the present fungus or *S. petricola* and encompassing both, may be appropriate. The morphological evidence, and the differences between our physiological results for the present fungus and those of others (cited in Table 1) for fungi coming from similar habitats do not, however, provide a sufficient basis to establish such a genus. There are, however, clear grounds for regarding the present fungus as a new species. The formal publication of a name and diagnosis of that species is carried out below.

Phaeococcomyces chersonesos Bogomolova & Minter, sp.nov. mycelium habet et non crescit meristematice. **Holotypus**: **LE** 212455, dried preserved specimen of culture Ch 49, isolated by E.B. Bogomolova from marble of the “Basilica in Basilica” monument, Chersonesos Archaeological Site, Crimea, Ukraine, August 1995. Isotypus: **IMI** 389175. Living cultures are maintained in the Laboratory of General Biophysics, Biology and Soil Sciences Faculty, St.Petersburg State University [Universitetskaya Emb. 7/9, 199034, St Petersburg, Russia] and CABI Bioscience [Bakeham Lane, Egham, Surrey, TW20 9TY, UK].

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FIRST CHECKLIST OF MACROFUNGI FOR THE DEEP WOODS ALL TAXA BIODIVERSITY INVENTORY, HOCKING COUNTY, OHIO, USA

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ABSTRACT

Deep Woods is the site of an all taxa biodiversity inventory (ATBI) overseen by the Ohio Biological Survey. Deep Woods encompasses 114 ha comprised of a diversity of habitats including fields, lowland and upland forests, riparian forest, hemlock ravines, sandstone outcrops, and rockhouse formations. During the 2002 growing season, the property was surveyed approximately every 10 days and fungi were collected and identified. In total, 92 species were collected with 12 species of ascomycetes, 74 species of basidiomycetes and 6 unknown. The fungi identified to species were further divided into groups based upon ecological guild: 13 soil-inhabiting, 7 litter-inhabiting, 50 wood-inhabiting, 13 mycorrhizal species, and 3 “other.” Our data indicate a diverse assemblage of macrofungi that is comparable to other studies in the Central Hardwood Region. Due to the ephemeral nature of fungal basidiomata, multiple years of study would certainly expand the species list.

Key words: Fleshy fungi, central hardwood region, Appalachia

INTRODUCTION

As a result of forest destruction, habitat loss and increasing global temperatures, biodiversity has become a salient issue during the last decade (Hawksworth 1991; Huston 1993; May 1991) and has provided momentum to document the diversity of life. The growth of biodiversity inventories has recently been enhanced with the recognition that microorganisms such as fungi and invertebrates (Wilson 1987) must be included. Fungi are essential in decomposing and recycling plant and animal remains (Arnolds 1995; Hawksworth 1991; May 1991; Rayner 1995) and as mycorrhizal associates. However, fungi are often poorly studied (Cannon 1997) and, until recently, commonly ignored in biodiversity studies (Hawksworth 1991). The object of this research was to provide a preliminary checklist of macrofungi as part of an all taxa biodiversity inventory (ATBI) occurring at Deep Woods, a mature second-growth forest community within the Cliff Section of the Cumberland and Allegheny Plateaus of the mixed mesophytic forest region in southeast Ohio (Braun 1950). The ATBI is overseen by the Ohio Biological Survey and the goal is to document all biological species occurring on the Deep Woods property.

MATERIALS AND METHODS

STUDY SITE

Deep Woods is 114 ha in size and comprised of a diversity of habitats including fields, lowland and upland forests, riparian forest, hemlock (*Tsuga canadensis* (L.) Carriere.) ravines, sandstone outcrops, and rockhouse formations (Riccardi and McCarthy In press). Deep Woods is located in Hocking County, Ohio (Figure 1) within the unglaciated Allegheny Plateau. Dissected hills and valleys dominate the area resulting in a total relief of 134 m. According to Woods et al. (1999) there are three soil orders at Deep Woods: alfisols, inceptisols and ultisols while Lemaster and Gilmore (1989) include a forth soil order: entisols. The climate of Deep Woods is temperate continental as temperature varies greatly throughout the year (Anonymous 1999). The January 30-year mean maximum and minimum temperatures are 29.3/16.1 C and, the July 30-year mean maximum and minimum temperature are 1.5/-8.9 C. The growing season can vary but often approaches 180 days.

METHODS

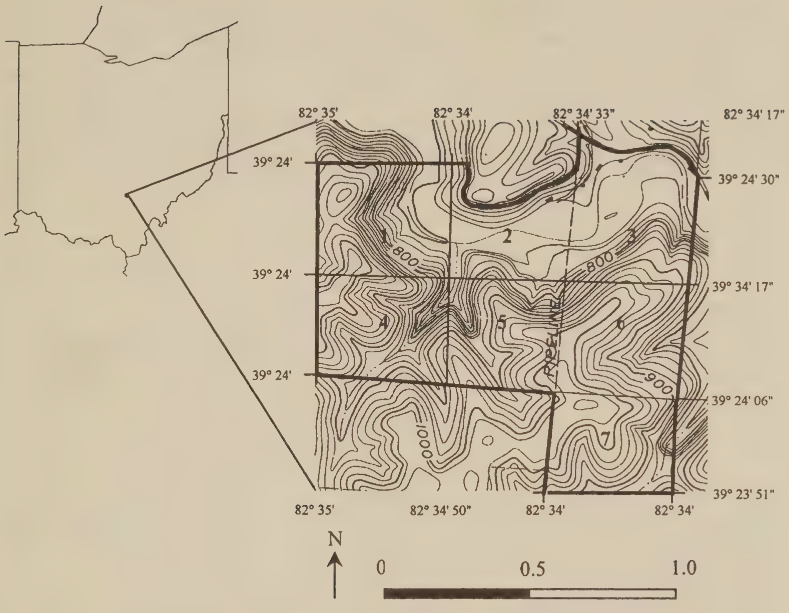
During the growing season, the property was surveyed approximately every ten days and voucher specimens of macrofungi encountered were collected and brought back to the laboratory for identification. When microscopic examination was required, fungal tissue was mounted in 5% KOH solution or Melzer's reagent (Largent et al. 1973). Several sources were used for species identification including Arora (1986), Bessette et al. (1997), and Gilbertson and Ryvarden (1986). Voucher specimens are housed in the Department of Environmental and Plant Biology, Ohio University.

RESULTS

A total of 92 species were collected with 12 species of ascomycetes and 74 species of basidiomycetes. The fungi were further divided into groups based upon ecological guild: 13 soil-inhabiting, 7 litter-inhabiting, 50 wood-inhabiting, 13 mycorrhizal species, 3 "other" and 6 unknown basidiomycetes.

DISCUSSION

The first checklist contributes to the ATBI and indicates a diverse assemblage of macrofungi. The diversity of macrofungi found during one growing season at Deep Woods is quantitatively comparable to a three-year study conducted in northeast Ohio (Bunyard 2001). Due to the ephemeral nature of fungal basidiomata, multiple years of study would certainly expand the species list (Cannon 1997). Further study at Deep Woods would also be enhanced by the adoption of a sampling method based on plots (Schmit et al. 1999).


82° 35'
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39° 24' 30"
39° 24'
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39° 24' 06"
39° 23' 51"
82° 35'
82° 34' 50"
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1
2
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4
5
6
7
800
800
900
1000
PIPELINE
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Fig. 1. Topographic map (portion of South Bloomingville quadrangle, USGS 1990) of Deep Woods showing property boundaries and quarter-quarter sections. Heavy black lines mark property boundaries. Quarter-quarter sections are numbered from 1-7. All elevations are in feet. Latitude ranges from 30°23'51" to 30°24'31". Longitude values range from 82°34'17" to 82°35'09". Scale is 4.2 centimeters equals 1.0 kilometer. Inset is map of Ohio showing the location of the study site.

SPECIES CHECKLIST

Species are listed alphabetically by genus and species within division, class and order with information on ecological guild: litter, mycorrhizal, other, soil, and wood. The unknown species are not listed. Taxonomic authority used was CABI Bioscience database FunIndex (http://www.speciesfungorum.org/).

ASCOMYCOTA

Hymenoascomycetes

Ascocoryne sarcoides (Jacq.) J.W. Groves & D.E. Wilson	Wood
Bisporella citrina (Batsch) Korf & S.E. Carp.	Wood
Chlorociboria aeruginascens (Nyl.) Kanouse	Wood

Cordyceps militaris (L.) Link	Other - Hymenoptera larvae
Hypoxylon fragiforme (Pers.) J. Kickx f.	Wood
Otidea leporina (Batsch) Fuckel	Soil
Peziza phyllogena M.C. Cooke	Soil
Sarcoscypha coccinea (Jacq.) Sacc.	Wood
Sarcoscypha occidentalis (Schwein.) Cooke	Wood
Scutellinia scutellata (L.) Lambotte	Wood
Urnula craterium (Schwein.) Fr.	Wood
Xylaria polymorpha (Pers.) Grev.	Wood

BASIDIOMYCOTA

Gasteromycetes

Dictyophora duplicata (Bosc) E. Fisch.	Soil
Lycoperdon perlatum Pers.	Soil
Lycoperdon pyriforme Schaeff.	Wood
Scleroderma citrinum Pers.	Mycorrhizal

Hymenomycetes

Agaricales

Agaricus abruptibulbus Peck	Soil
Agaricus placomyces Peck	Soil
Amanita citrina Pers.	Mycorrhizal
Amanita cokeri (E.-J. Gilbert & Kühner) E.-J. Gilbert	Mycorrhizal
Amanita vaginata (Bull.) Vitt.	Mycorrhizal
Armillaria mellea (Vahl) P. Kumm.	Wood
Armillaria tabescens (Scop.) Emel	Wood
Cantharellula umbonata (J.F. Gmel.) Singer	Soil, mosses
Clitocybe gibba (Pers.) P. Kumm.	Litter
Clitocybe nuda (Bull.) H.E. Bigelow and A.H. Sm.	Litter
Clitopilus prunulus (Scop.) Fr.	Soil
Coprinus micaceus (Bull.) Fr.	Wood
Cortinarius collinitus (Pers.) Fr.	Mycorrhizal
Crepidotus applanatus (Pers.) Fr.	Wood
Crepidotus mollis (Schaeff.) Fr.	Wood
Entoloma abortivum (Berk. & M.A. Curtis) Donk	Mycorrhizal
Flammulina velutipes (Curtis) Singer	Wood
Gymnopilus penetrans (Fr.) Murrill	Wood
Gymnopus dryophilus (Bull.) Murrill	Litter
Hygrophorus flavescens (Kauffman) A.H. Sm. & Hesler	Soil
Hygrophorus psittacinus Fr.	Soil
Lentinellus ursinus (Fr.) Kühner	Wood
Lepiota acutaesquamosa (Weinm.) P. Kumm.	Litter
Macrolepiota procera (Scop.) Singer	Soil
Marasmiellus candidus (Fr.) Singer	Wood
Marasmius capillaris Morgan	Litter
Marasmius rotula (Scop.) Fr.	Wood
Marasmius siccus Schwein.	Litter
Mycena galericulata (Scop.) Schaeff.	Wood
Mycena haematopus (Pers.) Quél.	Wood
Mycena leaiana Berk.	Wood
Mycena luteopallens Peck	Other - hickory nut & walnuts

Mycena pura (Pers.) Sacc.	Litter
Naematoloma sublateritium (Schaeff.) P. Karst.	Wood
Omphalotus illudens (Schwein.) Sacc.	Wood
Pholiota squarrosoides (Peck) Sacc.	Wood
Pleurotus ostreatus (Jacq.) Quél.	Wood
Pluteus cervinus (Schaeff.) P. Kumm.	Wood
Psathyrella rugocephala (G.F. Atk.) A.H. Sm.	Soil
Schizophyllum commune (L.) Fr.	Wood
Tricholomopsis platyphylla (Pers.) Singer	Wood
Xerula megalospora (Clem.) Redhead, Ginns & Shoemaker	Saprobic
Xerula radicata (Relhan) Fr.	Soil

Boletales

Gyroporus castaneus (Bull.) Quél.	Mycorrhizal

Cantharellales

Cantharellus appalachiensis R.H. Petersen	Mycorrhizal
Cantharellus lateritius (Berk.) Singer	Mycorrhizal

Clavariales

Clavicorona pyxidata (Pers.) Donk	Wood

Stereales

Stereum complicatum Fr.	Wood
Stereum ostrea Nees	Wood

Polyporales

Daedaleopsis confragosa (Bolton) J. Schröt.	Wood
Ganoderma applanatum (Pers.) Pat.	Wood
Ganoderma tsugae Murrill	Wood
Ischnoderma resinosum (Schrad.) P. Karst.	Wood
Laetiporus sulphureus (Bull.) Bondartsev & Singer	Wood
Lenzites betulina (L.) Fr.	Wood
Oxyporus populinus (Schumach.) Donk	Wood
Polyporus alveolarius (Bosc) Fr.	Wood
Polyporus badius (Pers.) Schwein.	Wood
Polyporus varius Pers.	Wood
Pycnoporus cinnabarinus (Jacq.) Fr.	Wood
Trametes versicolor (L.) Loyd	Wood
Trichaptum biformis (Fr.) Ryvarden	Wood
Tyromyces chioneus (Fr.) P. Karst.	Wood

Russulales

Lactarius vinaceorufescens A.H. Sm.	Mycorrhizal
Russula atropurpurea Peck	Mycorrhizal
Russula emetica Fr.	Mycorrhizal
Russula mariae Peck	Mycorrhizal

Phragmobasidiomycetes

Auricularia auricula (Hook. f.) Underw.	Wood
Dacrymyces palmatus (Schwein.) Bres.	Wood
Pseudohydnum gelatinosum (Scop.) P. Karst.	Wood

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OPHIOSTOMA QUERCUS OR OPHIOSTOMA QUERCI?

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ABSTRACT: The name *Ophiostoma quercus,* for a well-known and economically important sapstaining fungus occurring world-wide on hardwoods and commercially produced pines, is to be preferred over *O. querci* in view of grammatical rules of Latin.

KEYWORDS: species, specific epithet, nomenclature, oak decline, orthography

Ophiostoma quercus (Georgévitch) Nannf. is a fungus that occurs on various hardwoods such as *Quercus* and *Fagus* in the Northern Hemisphere (Brasier & Kirk, 1993). The fungus has often been associated with Oak Decline in central and eastern Europe (Anonymous, 1990), and is closely related to the Dutch Elm Disease pathogens *O. ulmi* (Buism.) Nannf. and *O. novo-ulmi* Brasier (Harrington et al., 2001). In the Southern Hemisphere, *O. quercus* is frequently found on hardwoods, but it also occurs commonly on commercially produced *Pinus* spp. (De Beer et al., 2003). Although not associated with tree diseases in the Southern Hemisphere, the fungus forms part of an economically important group of fungi associated with sapstain, or bluestain, of timber, reducing its commercial value.

In recent literature, considerable confusion existed surrounding the spelling of the species name. Some authors referred to the fungus as *O. querci,* while others used the name *O. quercus*. In this paper, we consider requirements pertaining to species names in the International Code of Botanical Nomenclature. Due to the nature of the contents of the paper, the spelling and capitalization of species epithets, as well as the spelling and abbreviation of author names, are cited exactly as they were printed in the original publications.

Ophiostoma querci was first described in 1926 as *Ceratostomella Querci* Georgévitch (Georgévitch, 1926). The following year, the same author changed the name to *Ceratostomella quercus* Georgevitch (Georgevitch, 1927). In 1934, the species was transferred to the genus *Ophiostoma* Sydow & P. Sydow, and the new combination was referred to as *Ophiostoma quercus* (Georgév.) Nannf. (Melin & Nannfeldt, 1934).

Moreau (1952) named the fungus *Ceratocystis querci* (Georgevitch) C. Moreau. Hunt (1956), without reference to Moreau's paper, synonymised what he called *Ceratostomella querci* Georgew., with *Ceratocystis piceae* (Münch) Bakshi.

Przybyl & De Hoog (1989) referred *C. piceae,* including *Ceratostomella querci* as a synonym, back to the genus *Ophiostoma,* following De Hoog & Scheffer's (1984) distinction between *Ophiostoma* and *Ceratocystis.* Brasier & Kirk (1989) suggested that the hardwood and conifer forms of *O. piceae* may be distinct species. For the previous 33 years, the hardwood form had been treated by most authors as a synonym of *O. piceae* (Hunt, 1956; Griffin, 1968; Olchowecki & Reid, 1973; Upadhyay, 1981; Hutchison & Reid, 1988; Przybyl & De Hoog, 1989). Brasier & Webber (1990) suggested that 'the name *O. querci* may need to be re-established for the hardwood taxon.' This was formally done by Morelet (1992), who referred to it as *Ophiostoma querci* (Georgévitch) Nannfeldt. The separation of the two species was confirmed by several studies (Brasier & Kirk, 1993; Brasier & Stephens, 1993; Przybyl & Morelet, 1993; Delatour et al., 1994; Halmschlager et al., 1994; Pipe et al., 1995; Kim et al., 1999; Harrington et al., 2001). However, confusion persisted in these and other publications about the correct ending of the epithet for the hardwood species. Most authors followed the suggestions of Brasier & Webber (1990) and Morelet (1992), referring to the hardwood species as *O. querci* (Brasier & Kirk, 1993; Brasier & Stephens, 1993; Przybyl & Morelet, 1993; Delatour et al., 1994; Farrell et al., 1997, 1998; Okada et al., 1998; Harrington et al., 2001). Some authors, however, chose to use *O.* ***quercus*** (Halmschlager et al., 1994; Pipe et al., 1995; Kim et al., 1999; Schirp et al., 1999; Xiao et al., 1999; Brasier, 2001; Gagné et al., 2001).

In only two papers, the choice of the spelling was motivated. The first was Halmschlager et al. (1994), who pointed out that '*Ophiostoma quercus* (Georgév.) Nannf. is the name Nannfeldt used in the original paper, when he placed *Ceratostomella quercus* in the genus *Ophiostoma.*' Furthermore, they stated that 'the name *O. querci* is not correct because in Latin the genitive of *Quercus* is *Quercūs* ("U"-declension)' (Halmschlager et al., 1994). Without referring to the paper of Halmschlager et al. (1994), Pipe et al. (1995) came to the same conclusion, stating that 'the genitive case of the Latin noun *quercus* (= oak), which is in the fourth declension, is *quercūs,* not *querci.*' The basionym for the species is, however, *Ceratostomella Querci* (Georgévitch, 1926), but this was rightly corrected by its original author in 1927 according to Articles 60.1 and 32.5 ICBN (Greuter et al., 2000). Most Latin dictionaries consider only the U-declension for the name of the oak, *Quercus.* Lewis & Short (1879), cite only one ancient writer who used the second declension genitive *querci,* namely Palladius Rutilius Taurus, who flourished c. AD 350, at a time when the standard of written Latin was at a low ebb. The use of the second declension genitive should, therefore, rather not be considered as a rule.

The combination proposed by Melin & Nannfeldt (1934), *Ophiostoma quercus,* was thus grammatically correct. In conclusion, we suggest that the species name should be referred to as follows:

Ophiostoma quercus (Georgévitch) Nannfeldt, Svenska Skogsvårdsföringens Tidskrift 3-4: 408. 1934 (basionym: *Ceratostomella quercus* (as '*Querci*') Georgévitch, *C. R. Acad. Sci.* 183: 759. 1926).

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SOME NEW RECORDS AND SPECIES OF DRYADICOLOUS FUNGI FROM GREENLAND AND NORTHERN ASIA

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Abstract: Sixteen fungus species were found on leaves, twigs and inflorescences of *Dryas integrifolia* and *D. octopetala* s.l. Descriptions, comments and illustrations of four new taxa, *Hymenoscyphus dryadis*, *Leptosphaeria holmiorum*, *Odontotrema alpinum* var. *octopartitum* and *Urceolella dryadicola,* are provided. The first records of some dryadicolous fungi from Greenland and Northern Asia are given.

Key words: *Hymenoscyphus*, *Leptosphaeria*, *Odontotrema*, *Urceolella*, Arctic

INTRODUCTION

Greenland is a vast island with very interesting Arctic mycobiota. Until recently, the dryadicolous fungi were reported by only a few authors (see Chlebicki & Knudsen 2001). Dryadicolous fungi from Asia are a so poorly investigated (Chlebicki 1998, 2002). We extracted some new species of fungi from *Dryas* collections deposited in C and LE as well as from the first author's collections gathered in the Polar Urals and Yamal Peninsula.

RESULTS

Cainiella johansonii (Rehm) E. Müll., Sydowia 10: 121, 1957. Sordariales

A conspicuous species, occurs mostly on midribs and veins of both sides of leaves and petioles. Its stout beaklike apex of ascoma, ascus with nonamyloid apical apparatus with 3-4 rings (Müller & Arx 1962, Barr 1990, Nograsek 1990) and very characteristic two-celled ascospores make it easily recognizable (Fig. 1.1).

SPECIMEN EXAMINED: GREENLAND, Fiskenfjord: Cave east of Qeqertat 64°59'N, 51°17'W, 25 m elev., on leaves of *Dryas integrifolia* , 9 July 1979, coll: *J. Feilberg*.

COMMENTS: *C. johansonii* occurs on leaves of *D. octopetala* L., *D. integrifolia* Vahl. and *D. drummondii* Richards. (Holm 1979, Barr 1959, Nograsek 1990, Chlebicki 1995). Holm (1979) on the basis of the *Dryas* collections in UPS has extended the known distribution to the Faroe Islands, Spitsbergen and Novaya Zemlya. Spooner (1981) reported three finds from Scotland. Fisher et al. (1995) found it to be a dominant species among endophytic fungi isolated from *Dryas* leaves collected in Spitsbergen. Vassiljeva (1998) noted it in Wrangel Island, Kamchatka and the Chukotka Peninsula on *Dryas punctata* Juz. Chlebicki (1998) reported some finds from the Polar Urals. It is probably a widely distributed species in Arctic and alpine areas of the Northern Hemisphere.

Didymosphaeria massarioides Sacc. & Brunaud, Michelia 2: 392, 1881. Dothideales
Syn.: *Didymosphaeria striatispora* Nograsek, (non *D. striatispora* Syd.), *Didymosphaeria lineatispora* Nograsek in Nograsek & Matzer

Ascocarps oval, immersed, asci cylindrical, ascospores egg-shaped, two-celled, not constricted, brown 16-20 x 7-9 µm with slightly marked light (!) stripes.

SPECIMEN EXAMINED: GREENLAND, Nyeboe Land, Frankfield Bugt, 82°07'N, 55°56'W, 1 m elev., on inflorescence of *D. integrifolia*, 27-28 July 1986, coll.: *Ch. Bay*.

COMMENTS: *D. massarioides* seems to be a cosmopolitan species, noted on *Dryas octopetala*, *Fraxinus excelsior* L., *Ilex aquifolium* L., *Lycium barbarum* L., *Rubus idaeus* L., *R. ulmifolius* var. *chilensis* H. Lév. (= *R. sanctus* Schreb.) and *Sambucus nigra* L. (Aptroot 1995). Nograsek (1990) and Chlebicki (2002) noted it on *Dryas* wood in the Alps and Carpathians.

Gnomoniella vagans Johanson, Öfv. K. Sv. Vet.-Akad. Förhandl. 9: 163, 1884. Diaporthales

Ascocarps immersed, stromatic tissues absent, beaks elongate, asci clavate, ascospores hyaline, two-celled 11-13 x 4.5-6 µm with very short basal cell ca 1.5 µm long.

SPECIMENS EXAMINED: RUSSIA, Polar Ural Mts., tundra on moraine near Sob River, 250 m elev., ca 5 km S of Polyarnyj Ural railway station, on hypanthium and pedicel of *D. octopetala*, 26 July 1995, coll.: *A. Chlebicki* (KRAM F); GREENLAND, Søndre Strømfjord, N of Arnangarngup Kûa 66°31'N, 51°20'W, 350 m elev., on inflorescence of *D. integrifolia,* 21 July 1983, coll: *B. Fredskild & S. Holt.*

COMMENTS: This very rare species was reported by Barr (1959) on *Dryas integrifolia* from Baffin Island (Canada). Holm (1979) cited Johanson's localities from Sweden and Iceland. K. Holm and L. Holm (1993) found it in Spitsbergen on *D. octopetala*. Chlebicki (2002) reported it from the Kola Peninsula.

Heteropatella umbilicata (Pers.) Jaap, Annales Mycol. 5: 266, 1907. Mitosporic fungus

Conidiomata superficial, conidia hyaline 3-euseptate 17-22 x 2-3 µm, upper cell with filiform appendage 10-16 µm long (Fig. 1. 2), basal cell with a short appendage up to 2 µm.

SPECIMEN EXAMINED: GREENLAND, Nûgssuaq – Halvöen, on inflorescence of *Dryas integrifolia*, 13 July 1932, coll: *J. Grantved.*

COMMENTS: It was reported on many herbaceous plants and woody debris from Europe, North America and Greenland (Sutton 1980, Farr et al. 1989, Chlebicki 2002).

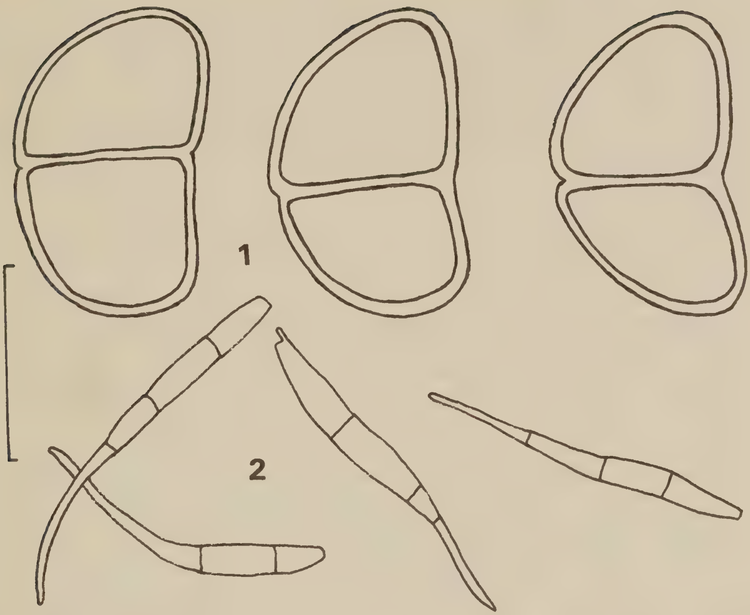

Fig. 1. *Cainiella johansonii*: 1- ascospores, *Heteropatella umbilicata*: 2 - conidia, scale 20 µm

Hymenoscyphus dryadis Raitv. *species nova*, Helotiales

Diagnosis: *Hymenoscypho virgultoro similis, sed differt ascis brevioribus 85-110 x 6-9 µm, ascosporis non guttulatis angustioribus, 15-20 x 3.5-4 µm. et habitatione in Dryadibus.*

HOLOTYPUS: *Groenland, Dundas, in latere meridionali montis Akinaarssuk, 76°33'N, 68°44'W, alt. 250 m, in Dryade putrida crescit, 16 VIII 1988, S.A. Elborne legit* (C).

Macroscopically like *H. virgultorum*. Apothecia up to 2.5 mm in diam., stipitate, shallow cupulate, disc pale yellowish, outside pale yellowish, slightly white-velutinous. Stipe long, 3.5-5 x 0.5 mm, slightly velutinous, pale yellowish. Ectal excipulum composed of thin-walled, hyaline *textura prismatica*. Ascogenous hyphae without croziers. Asci arising from simple septa, cylindrical, 8-spored, 85-110 x 6-9 µm, pore MLZ+. Spores irregularly biseriate, fusoid, slightly inequilateral, without prominent lipid globules, mostly with homogeneous, sometimes with finely granular content, 15-20 x 3.5-4 µm.

HOST: on *Dryas* debris

ETYMOLOGY: refers to growing on *Dryas*.

HOLOTYPE: NW-Greenland, Dundas, S-side of Mt. Akinaarssuk, 76°33'N, 68°44'W, on dead *Dryas* debris in *Dryas* heath, under metal plate, ca 250 m elev., 16 August 1988, coll.: *S.A. Elborne* (Holotype in C).

COMMENTS: *Hymenoscyphus virgultorum* (Weber) W. Phillips is a clear-cut species characterized by long, 120-140 x 8-11 µm asci and spores with high lipid content, measuring 13-19 x 4-5 µm. It grows on decaying hardwood. *H. dryadis* differs in smaller asci and slender spores lacking big lipid globules.

Leptosphaeria holmiorum Chleb. *species nova*, Dothideales

Diagnosis: *Ascomata globosa, nigra, 180-200 µm diam., asci claviformes vel anguste ellipsoidei, tetraspori 110-140 x 20-21 µm, assporae pallide ochraceae vel olivaceae, (2)3-4(5) septatae, ad septum medium constrictae, 32-42 x 10-14 µm.*

A Leptosphaeria dryadophila Huhndorf *ascis tetrasporis et ascosporis maioribus differt*

HOLOTYPE: RUSSIA, Chukotka Peninsula, Valley of Anadyr River, Novina, 31 July 1932, coll.: *J. Moshovi*, (LE).

HOST: on petioles of *D. crenulata* Juz. x *incisa* Juz. (host det.: *Y.P. Kozhevnikov*) = *D. integrifolia* s. l.

ETYMOLOGY: *holmiorum* refers to the famous mycologists Kerstin and Lennart Holm from Uppsala.

Ascocarps 180-200 µm diam., oval with distinct ostiole, erumpent or partially embedded in substratum (Fig. 2.1), ascocarp wall 40-46 µm thick, scleroplectenchyma of ascocarp peridium *textura angularis* (Fig. 2.2), asci tetrasporous (Fig. 2.3), clavate 110-140 x 20-21 µm, ascospores olivaceous to pale ochraceous, mostly 3-septate but also 4- and rarely 2- or 5-septate, constricted at the medium septum, 32-42 x 10-14 µm, Chukotka: 34-42 x 11-14 µm (Fig. 2.4), Caucasus: 34-38 x 10.5-12 µm, (Fig. 2.5), Polar Urals: 32-37 x 10-12 µm (Fig. 2.6).

SPECIMENS EXAMINED: RUSSIA, Chukotka Peninsula, Valley of Anadyr River, Novina, on petioles of *D. crenulata* x *incisa* (host det.: *Y. P. Kozhevnikov*), 31 July 1932, coll.: *J. Moshovi* (HOLOTYPE: LE); Polar Ural Mts., near Khodata River, on petiole of *D. octopetala*, 8 August 1961, coll.: *K. N. Igoshina* (LE); Caucasus, Abkhasia: Gudanta, Abats and Tagzhdzhhi itaza, 1900-2200 m elev., on petiole of *D. octopetala* subsp. *caucasica* (Bornm.) Hultén, 24 July 1935, coll.: *A. Kolakovsky* (LE).

COMMENTS: It is a very characteristic species with constantly tetrasporous asci and variable septation of ascospores. It differs distinctly from the common species *L. dryadophila* Huhndorf, recently included in the genus *Leptosphaeria* by Huhndorf (1992). According to L. Holm (in letter) the scleroplectenchyma of the ascocarp peridium is typical for *Leptosphaeria*; apart from them it is the first species of *Leptosphaeria* with tetraspored asci. *L. holmiorum* is restricted to the stalks. It is an Arctic-alpine species so far reported only from Eurasia.

Leptosphaerulina dryadis (Starbäck) L. Holm, Bot. Notiser 132: 86, 1979. Dothideales

Ascocarps immersed ca 100 µm diam., ascospores hyaline, broadly obovoid, muriform 22-30 x 9-10 µm.

SPECIMEN EXAMINED: GREENLAND, Fiskenfjord: Cave east of Qeqertat 64°59'N, 51°17'W, 25 m elev., on leaves of *Dryas integrifolia*, 9 July 1979, coll: *J. Feilberg*.

COMMENTS: It is an Arctic-alpine species, so far reported from Europe (Holm 1979, Nograsek 1990, Chlebicki 1995), the Far East in Asia (Vassiljeva 1998), North America (Barr, in letter), northern Asia and Korea (Chlebicki 2002).

Lophiostoma appendiculatum Fuckel, Symb. Myc. App. 2: 29, 1873. Dothideales

Ascocarps immersed-erumpent, asci clavate, 87-100 x 12-13 µm, ascospores fusiform, slightly caudate with obtuse ends, appendages absent, 3th or 4th cell darker, the end cells hyaline 30-33 x 6-7 µm (Fig. 3).

SPECIMEN EXAMINED: GREENLAND, NW Disko, Hammers Dal, N of the river 70°09'N, 54°43'W, 250 m elev., on twigs of *Dryas integrifolia*, 30 July 1984, coll: *H. Burge & A. Michelsen*

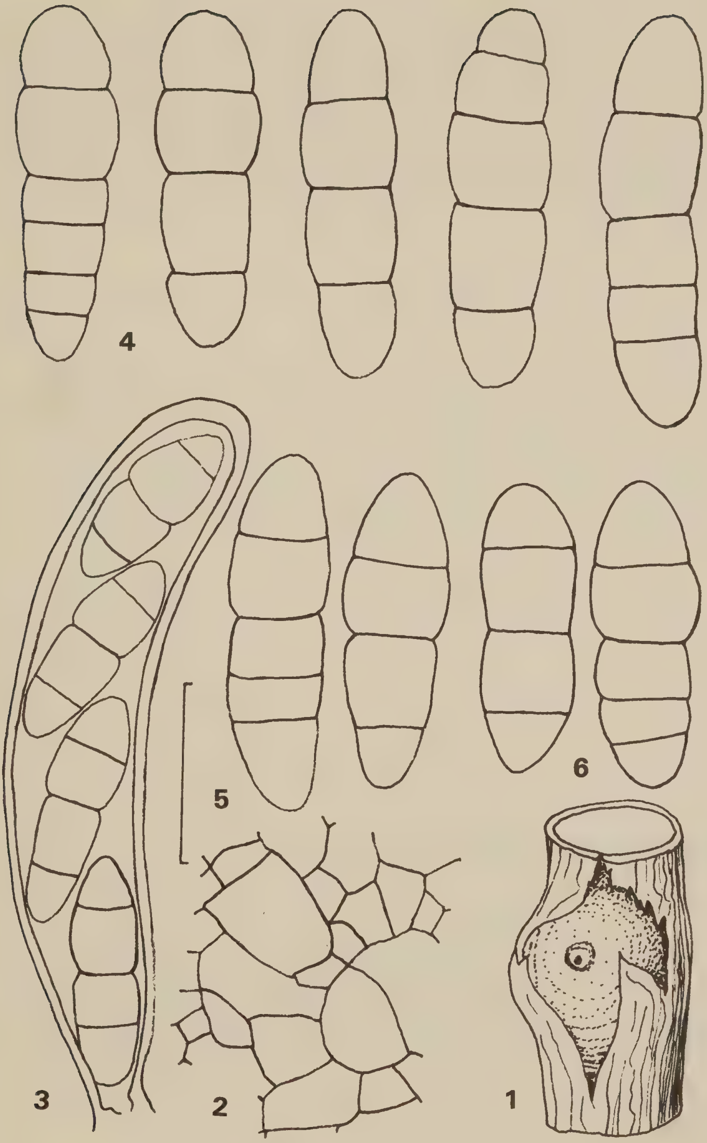

Fig. 2. *Leptosphaeria holmiorum*: 1 - ascocarp, 2 - part of ascocarp peridium (*textura angularis*), 3 - ascus, 4 - ascospores (Chukotka Peninsula), 5 - ascospores (Caucasus), 6 – ascospores (Polar Urals), scale 20 µm

COMMENTS: *L. appendiculatum* occurs mostly on various species of the genus *Salix* (Munk 1957, L. Holm & K. Holm 1988, Nograsek 1990) but also on *Quercus*, *Fraxinus* and other host plants. The Greenland collection is an intermediate form between *L. caulium* (Fr.) Ces. & De Not. var. d (sensu L. Holm & K. Holm 1988, p. 14), and *L. caudatum* Fabre. Chesters and Bell (1970) supposed that *L. caudatum* is derived from the *caulium* group. According to L. Holm and K. Holm (1988), *L. appendiculatum* is closely related to *Lophiostoma caulium*. The ascospores from Greenland are very similar to those of *L. appendiculatum* as described by Nograsek (1990).

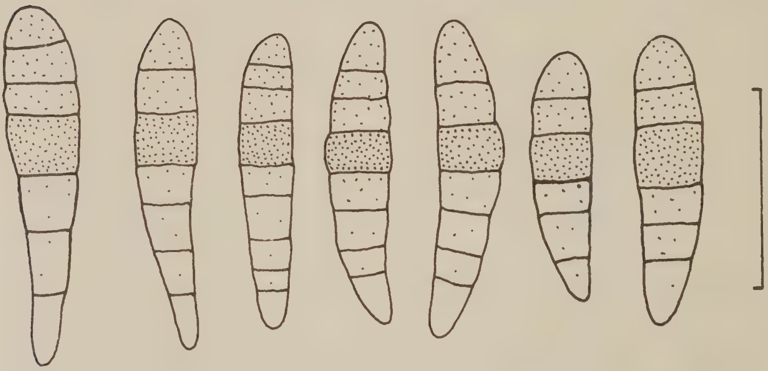

Fig. 3. *Lophiostoma appendiculatum*: ascospores, scale 20 µm

Melaspilea hyparctica K. Holm & L. Holm, Bibl. Mycol. 150: 55, 1993. Arthoniales (Melaspileaceae)

Ascocarp superficial, elliptic (Fig. 5A), black, ascospores ellipsoid, two-celled, brown 27-33 x 12-17 µm, upper cell broader.

SPECIMEN EXAMINED: RUSSIA: Yamal Peninsula, Yangana-Pe massif, on calcareous plateau, on dead twigs of *Dryas octopetala* subsp. *punctata* (Juz.) Hultén, 26 August 1996, coll.: *A. Chlebicki.*

COMMENTS: It is a lignicolous species, noted on wood of *Dryas octopetala* in Norway, Spitsbergen and the Alps (K. Holm & L. Holm 1993, Nograsek & Matzer 1991). Chlebicki (2002) noted it in the Sayan Mts. (SE Siberia).

Mycosphaerella tassiana (De Not.) Johanson, Öfv. K. Sv. Vet.-Akad. Förhandl. 9: 167, 1884. Dothideales

SPECIMEN EXAMINED: GREENLAND, NW Disko, N of Hammers Dal 70°10'N, 54°50'W, 10 m elev., on sepals and ovaries of *D. integrifolia*, 28 July 1984, coll: *H. Byrge & A. Michelsen.*

COMMENTS: This common species was earlier mentioned by Lind (1910, 1934) from Greenland on *Cerastium alpinum* L.

Naemacyclus lambertii Rehm var. ***dryadis*** K. Holm & L. Holm, Sydowia 38: 137, 1985. Rhytismatales

Apothecia circular, white, ascospores hyaline, septate 54-70(-90) x 1.8-2 µm, paraphyses up to 140 µm long.

SPECIMEN EXAMINED: RUSSIA: Chukotka Peninsula, near Uzhen, on twigs of *D. octopetala* var. *pilosa* Bab., 1 August 1959, coll.: *T. G. Derviz-Sokolova* (LE).

COMMENTS: *N. lambertii* var. *dryadis* was reported from the Alps (K. Holm & L. Holm 1985, Nograsek & Matzer 1991), northern Sweden (Nograsek & Matzer 1991), Spitsbergen (K. Holm & L. Holm 1993), the Polar Urals (Chlebicki 1998) and Greenland (Chlebicki & Knudsen 2001).

Odontotrema alpinum (Sacc.) L. Holm var. ***octopartitum*** Raitv. & Chleb. *var. nov.* Ostropales

Diagnosis: *Varietatis typicae similis, sed differt ascosporis longioribus 7-septatis differt.*

HOLOTYPUS: *Groenlandia, Tupertalik, 65°30'N, 51°55'W, ad folia Dryadis integrifoliae, 19 VII 1977, coll. V Alstrup legit* (C).

Ascocarps are macroscopically and in their sterile structures identical with those of the type variety. Asci cylindrical, slightly saccate at maturity (Fig. 4.1), 8-spored, 55-65 x 5-8 µm, thick apical cap and pore MLZ-. Spores cylindric-fusoid, sometimes slightly clavate, hyaline 7-septate (Fig. 4.2), slightly constricted at the septa, without inclusions, 20-27 x 3.5-5 µm. Paraphyses cylindrical, exceeding the asci, 1-1.5 µm wide. Hymenial gel diffusely pale blue in MLZ.

HOST: on the under surface of *Dryas integrifolia* leaves.

ETYMOLOGY: *octopartitum* refers to the 8-celled ascospores of the fungus..

HOLOTYPE: GREENLAND, Tupertalik, 65°30'N, 51°55'W, on leaves of *Dryas integrifolia,* 19 July 1977, coll.: *V Alstrup* (C).

COMMENTS: *Odontotrema alpinum* (Sacc.) L. Holm is similar to *O. cassiopes* (Rostr.) L. Holm reported it on *Cassiope tetragona* D. Don. The type collection of *O. alpinum* has been gathered on *D. octopetala* from the Alps. Sherwood-Pike (1987) reported the same species on *Sieversia* = *Geum* from France and Switzerland. So far *O. alpinum* was recognized as an Alpine species (Müller & Arx 1955, Holm 1979). Chlebicki (2002) noted the species on both sides of leaves of *Dryas octopetala* in the Kola Peninsula. It can be temporarily included in the group of Arctic-alpine species (Chlebicki 2002). A new variety of the species is known only from the western part of Greenland. Its erratic distribution is difficult to explain; however, it seems to be restricted to *D. integrifolia*.

Phaeosphaeria dryadea Nograsek; Bibl. Mycol. 133: 179, 1990. Dothideales

Ascocarps superficial, covered by hairs, asci cylindric, ascospores 4-celled.

SPECIMEN EXAMINED: GREENLAND, Lersletten, point 230 m NE of Qaersulik 68°24'N, 51°59'W, 200 m elev., on leaves of *Dryas integrifolia*, 11 July 1991, coll: *J. Feilberg.*

COMMENTS: The species was reported from the Alps (Nograsek 1990) and Carpathians (Chlebicki 1995) on *Dryas octopetala* as well as from the Chukotka Peninsula on *Dryas grandis* Juz. (Chlebicki 2002).

Pyrenopeziza holmiorum Nograsek & Matzer, Nova Hedwigia 53: 461, 1991. Helotiales

Apothecia erumpent on lower surface of leaves, solitary to scattered. Disc 0.15-0.33 mm in diameter, concave, greyish when resoaked. Receptacle at first almost globose, later cup-shaped, medium brown to dark brown, with pubescent margin. Ectal excipulum composed of *textura globulosa-angularis*, cells medium brown to dark brown, firm-walled, 4.5-8 µm. Surface layer of excipulum is composed of scattered groups of very dark brown, often almost opaque cells. Marginal hairs cylindrical to slightly clavate, apically broadly rounded, hyaline, thin-walled (Fig. 4.3), sometimes finely rough, 20-40 µm. Asci arising from croziers, cylindric-clavate to clavate (Fig. 4.4), 8-spored, 30-45 x 4-7 µm, pore blue in IKI and MLZ. Spores irregularly biseriate or obliquely uniseriate, hyaline, cylindric-fusoid, sometimes slightly clavate, aseptate, containing 2 big or several small lipid globules (Fig. 4.5), 7-9 x 2-2.5 µm. Paraphyses cylindrical, not exceeding the asci, 1-2 µm wide, without inclusions.

SPECIMEN EXAMINED: GREENLAND, Disko, Mellenfjord, Enoks Havn, 69°44'N, 54°48'W, on leaves of *Dryas integrifolia*, 17 July 1983, coll.: *J. Feilberg*.

COMMENTS: The species was reported from Norway, Sweden and the Austrian Alps on leaves of *Dryas octopetala* (Nograsek & Matzer 1991) and it seems to be common in the Alps but very rare in Greenland.

Synchytrium cupulatum F. Thomas, Botan. Centr. 29: 22, 1887. Chytridiales

Syn.: *Synchytrium myosotidis* var. *dryadis* Thomas

It is short cycled species, resting spore galls scattered or aggregated, carmine-red and cup-shaped with constricted base.

SPECIMEN EXAMINED: GREENLAND, Sarqardlîp Nunå, W end at Manermiut, 50 m. elev., 68°36'N, 53°08'W, on leaves of *D. integrifolia*, 17 August 1986, coll.: *F. R. Petersen*; Disko, Rødeelv hear, Godhavn 69°19'N, 53°33'W, 50 m elev., on leaves of *D. integrifolia*, 30 July 1963, coll: *S. Laegaard*; Werner Bjerge, Schuchert Dal E-slope of the valley 71°48'N, 24°19'W, 220 m elev., on leaves of *Dryas octopetala* x *D. integrifolia*, 4 August 1991, coll.: *F. H. Schwarzenbach*. RUSSIA, Chukotka Peninsula, environs of Naukan, on leaves and petioles of *Dryas octopetala* L. s. l. (*D. ajanensis* subsp. *beringensis* B. A. Jurtzev var. *viridis*), 17 July 1958, coll.: *B. Tikhomirov* (LE).

COMMENTS: *S. cupulatum* was reported from Austria, Canada, Iceland, Finland, Norway (including Spitsbergen), Greenland and Switzerland, on living leaves, petioles, calyces and petals of *D. octopetala* and *D. integrifolia* (Hagen 1941, Karling 1956, Savile 1959, Chlebicki 2002). It seems to be the most primitive fungus found on *Dryas*. Recently a rich collection of the late J. Poelt from the Italian Alps was distributed and published (Scheuer 1999, *Mycotheca Graecensis* Nr. 217).

Urceolella dryadicola Raitv. *species nova*, Helotiales

Diagnosis: *Apothecia sessilia, turbinata, sparsa vel gregaria, 0.1-0.2 mm in diametro, disco plano, albido. Receptaculum album, pilis albis obtectum. Excipulum ectale ex textura prismatica-porrecta compositur, cellulis hyalinis subcrassiter tunicatis, MLZ-, CR+. Pili conici vel cylindraceo-conici, hyalini, aseptati, crassiter vitreitunicatis, saepe tuberculati CR-, MLZ-, 25-80 x 3.5-5 µm, apicibus 1.5-2.2 µm latis. Asci uncinati, cylindraceo-clavati, octospori, 30-45 x 4-5 µm, poro iodo pallide caerulescentia praediti. Sporae biseriatae vel oblique uniseiatae, anguste fusoideae, hyalinae, aseptatae, eguttulatae, 7-9 x 1.2 µm. Paraphyses filiformes, ascos non superantes, 1-1.2 µm latis.*

Ad folia sicca Dryadis crescit.

HOLOTYPUS: *GROENLANDIA, Inglefield Bredning, Qeqertat, ad folia sicca Dryadis integrifoliae, 77°30'N, 66°38'40"W, 12 VIII 1980, B. Fredskild legit* (C, *isotypus* TAA)

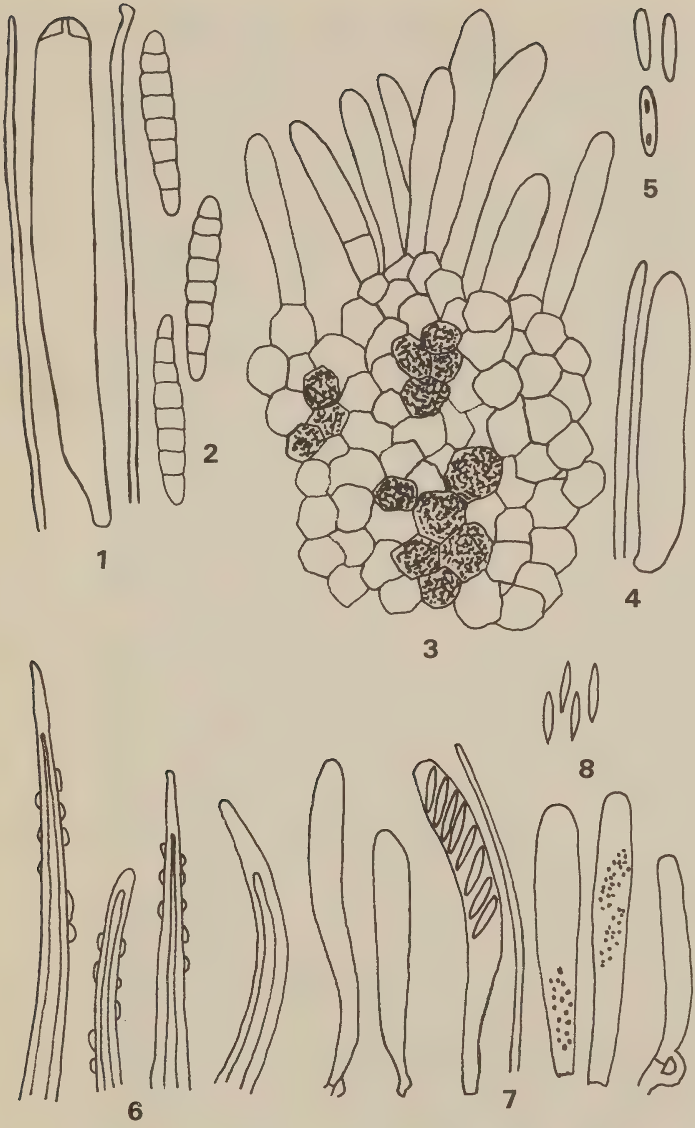

Fig. 4. *Odontotrema alpinum* var. *octopartitum*: 1 - ascus and paraphyses, 2 - ascospores; *Pyrenopeziza homiorum*: 3 - marginal hairs, 4 - ascus, 5 - ascospores; *Urceolella dryadicola*: 6 - marginal hairs, 7 - asci and paraphyses, 8 - ascospores, scale 20 µm

Apothecia sessile on lower surface of leaves (Fig. 5 B), scattered to crowded. Disc 0.1-0.2 mm in diameter, plain, whitish. Receptacle turbinate, whitish, covered with white hairs. Ectal excipulum composed of *textura prismatica-porrecta*, cells hyaline, firm-walled, remaining hyaline in MLZ, staining deep red in CR. Hairs conical to cylindric-conical, hyaline, with thick glassy walls, losing glassiness in 3% KOH, often partly covered with low, wide tubercules, remaining hyaline in CR and MLZ (Fig. 4. 6), 25-80 x 3.5-5 µm, apically 1.5-2.2 µm wide, lumen continuous, aseptate, ending up to 5µm below the apex. Asci arising from croziers, cylindric-clavate, 8-spored (Fig. 4.7), 30-45 x 4-5 µm, pore faintly blue in MLZ. Asci often contain 1 or 2 more or less fusoid groups of brown droplets visible in KOH, disappearing in MLZ. Spores irregularly biseriate or obliquely uniseriate, hyaline, narrowly fusoid, aseptate, without inclusions (Fig. 4.8), 7-9 x 1.2 µm. Paraphyses filiform, not exceeding the asci, 1-1.2 µm wide.

HOST: on dead leaves of *Dryas integrifolia* (Fig. 5 B, C).

ETYMOLOGY: *dryadicola* refers to the host name.

SPECIMENS EXAMINED: GREENLAND, Inglefield Bredning, Qeqertat, 77°30'N, 66°38'40"W, 12 August 1980, coll.: *B. Fredskild* (Holotype in C, isotype in TAA). Piulip Nana, Ingelfield Bredning, 77°43'N, 69°25'W, 30 July 1987, coll.: *W. Higgs*. Om Nuk, Semilik, 66°07'N, 37°32'W, 21 July 1933, coll.: *R. Bøgvad*.

COMMENTS: This species may be endemic to Greenland. The brown droplets visible mostly in immature asci have no taxonomic value but seem to be a specific feature occurring in several arctic Helotiales belonging to different families.

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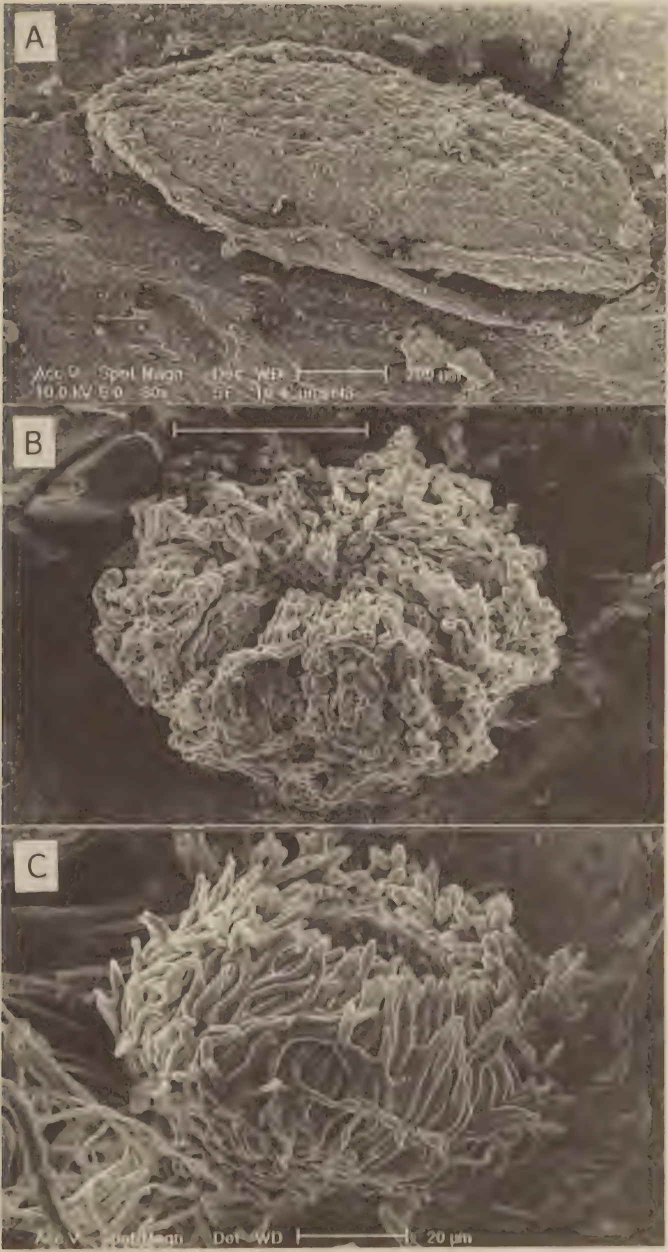
Fig. 5. *Melaspilea hyparctica*: A - ascocarp, scale 200 µm; *Pyrenopeziza holmiorum*: C - ascocarps, scale 50 µm; *Urceolella dryadicola*: B - ascocarp, scale 20 µm


A
Acc.V Spot Magn Det WD
10.0 kV 5.0 80x SE
200 µm
B
C
Det WD
20 µm

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ENTOLOMA ALLIODORUM, A NEW SPECIES OF SUBGENUS CLAUDOPUS WITH A GARLIC ODOUR

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Abstract: *Entoloma alliodorum* is described as a new species belonging to subgenus *Claudopus*. It is mainly characterized by its garlic smell, small size, whitish colours and pleurotoid-omphalioid habit. The new species was found in an *Abies pinsapo* forest in Andalusia (Spain), growing on mosses and rotten debris. Taxonomic comments on other species which share this particular organoleptic character or morphologically similar taxa are made. A photograph of the holotype and line drawings of the microscopic characters are added. The new nomenclatural combinations *Entoloma vinaceocontusus* and *E. graveolens* are proposed.

Keywords: Entolomatales, taxonomy

INTRODUCTION

Agarics showing a garlic smell are really uncommon in the mycological literature, though some of them show a wide distribution and are well known in some northern hemisphere countries [e.g. *Marasmius alliaceus* (Jacq.: Fr.) Fr., *M. scorodonius* (Fr.: Fr.) Fr.]. Only a few species of *Entoloma* (Fr.) P. Kumm. *sensu lato*, have been reported to show this peculiar organoleptic character; as far as we know, *Entoloma mephiticum* (Murrill) Hesler (MURRILL, 1915; BARONI, 1990), *Claudopus vinaceocontusus* T.J.Baroni (BARONI, *loc. cit.*) and *C. graveolens* Largent (LARGENT, 1976, 1994), all of them belonging to subgenus *Claudopus* W.G. Sm., were described from North America with either a mephitic (pungent) or a garlic-like odour.

Entoloma alliodorum, the new species proposed in this contribution, was found abundantly on rotten, fallen wood debris covered with mosses and lichens, in an *Abies pinsapo* Boiss. forest; this conifer tree is exclusively bound to hyperhumid areas of some western mediterranean countries (Morocco, Spain), which have been the object of previous mycofloristic contributions (ORTEGA *et al.*, 1996, 2002).

In order to propose this new species, an extensive bibliographic search dealing with *Claudopus* taxa from both Hemispheres has been made (DENNIS, 1961; HESLER, 1967; HORAK, 1973 and 1982; MANIMOHAN *et al.*, 2002; NOORDELOOS, 1988, 1992 and 1994; PEGLER, 1977a, 1977b and 1986; SINGER, 1975; WATLING & GREGORY, 1989), and we have not been able to find a taxon which fits the particular combination of organoleptic and macro-micromorphological characters of *E. alliodorum*.

MATERIAL AND METHODS

The description of *E. alliodorum* has been based on the examination of a large collection containing more than a dozen fresh specimens. The holotype has been deposited in AH and one paratype in ZT.

The photograph of the basidiomata was taken in the field. All drawings were made using a camera lucida device. Colours are referred to MUNSELL (1994) and spore measurements follow the method proposed by HEINEMANN & RAMMELOO (1985). Authors abbreviations are according to KIRK & ANSELL (1992).

Entoloma alliodorum Esteve-Rav., E. Horak & A. Ortega, ***spec. nov.*** (Figs 1-4)

Etymology : from Latin "*allium*" = garlic and "*odor*" = smell, because of its smell of garlic.

Basidiomata gregaria vel dispersa. Pileus 3-8(-10) mm latus, convexus vel plano-convexus, centro depressus, haud translucido-striatus, haud hygrophanus, albus, fibrilloso-tomentosus. Lamellae 15-22 stipitem attingentes, usque ad 2 mm latae, subconfertae, arcuatae vel decurrentibus, albae demum roseae, margine concolores. Stipes 6-10 x 0,5-1 mm, manifestus, subexcentricus, curvatus, albus, leviter fibrillosus, basi fibrillis albis substrato affixus. Caro tenuis, odore alliaceo manifesto, sapore ignoto. Sporae 8,8-10,9 x 6,2-7,7 µm, $\underline{Q}$ = 1,4, 6-7 angulatae. Basidia clavata, 4-sporigera, fibulata. Cystidia nulla. Pileipellis cutis vel trichodermatis hyphis inflatis, 5-15 µm latis, haud pigmentatis. Fibulae in hymenio praesentes, in aliis partibus carposomatum nullae.
In nemoribus sub Abies pinsapo, inter et in muscos et ligneos putridos ad terra humosa.

Holotypus: AH 16907; Paratypus in ZT.

Basidiomata gregarious with pleurotoid to omphalioid habit. Pileus 3-8(-10) mm in diam., convex to plano convex, becoming applanate-depressed with age, with slightly involute margin when young, not umbonate, not distinctly hygrophanous, when moist initially not translucently striate, surface dull, finely fibrillose to pubescent, not lubricous, in some specimens rivulose or with concentric zones, entirely white when young, becoming cream-ochraceous when dry. Lamellae 15-22, moderately distant, arcuate-decurrent, frequently forked and sometimes anastomosing, -2 mm wide, white, becomink pink, with concolorous, entire edge. Stipe very distinct, 6-10 x 0.5-1 mm, weakly to distinctly eccentric, often curved, white, tapering towards the base, finely fibrillose, the base covered by abundant whitish mycelium hairs. Context thin, whitish. Smell strong of garlic, especially some minutes after collection or when basidiomata are enclosed in a box or aluminium paper. Spore print pink.

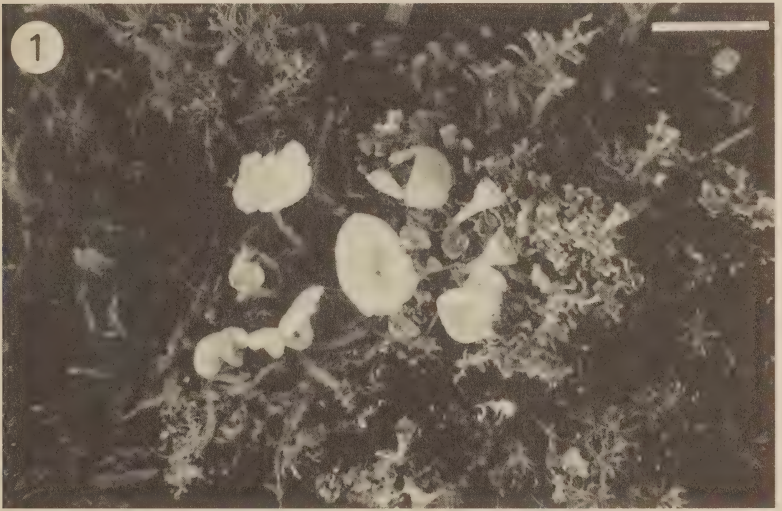


Fig 1. ***Entoloma alliodorum*** (AH 16907, holotype). Basidiomata growing on and among mosses and lichens. Bar= 10 mm.

Spores 8.8-9.8-10.9 x 6.2-7-7.7 µm; Q = 1.4; (n=21), heterodiametrical, 6-7 angled in side view, with well marked angles, uni-guttulate. Basidia 30-36(-42) x 11.5-14 µm, shortly clavate, 4-spored, clamped at the base. Lamella edge fertile. Cheilo- and pleurocystidia absent. Hymenophoral trama formed by parallel to subparallel short hyphae, 5-15 µm wide, clampless. Subhymenium made up of short, subisodiametric hyphae, -10 x 5 µm. Pileipellis a cutis with transitions to a trichoderm, made up of cylindrical to inflated hyphae, 5-15 µm wide, with numerous, cylindrical to subclavate terminal elements, without pigment. Hipocutis hardly differentiated, with parallel and cylindrical hyphae -20 µm wide, without pigment. Clamps only present at the base of basidia.

Habitat: on organic debris, among mosses (*Homalothecium sericeum* and *Pleurochaete squarrosa*) and lichens (*Cladonia sp.*) and very rotten wood of *Abies pinsapo*, *Cistus albidus* and *Ulex baeticus*.

Material studied: Spain: *Málaga*, Yunquera, Sierra de las Nieves, Tajo de la Caína., 30SUF286655, alt. 1100 m, 1-XI-1994, in *Abies pinsapo* forest, Leg. *L.*

Alcoba, F. Esteve-Raventós, E. Horak & A. Ortega, AH 16907 (holotype), paratype in ZT.

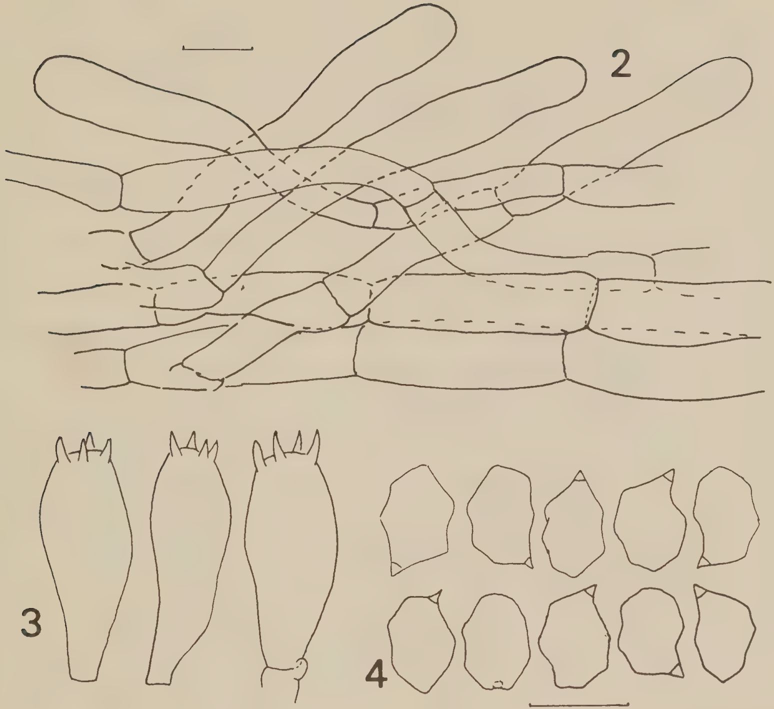
DISCUSSION

Apart from the peculiar smell, *E. alliodorum* is macroscopically characterized by its whitish colours, well-developed stipe and numerous, subdistant lamellae. Microscopically, the absence of cystidia, pileipellis with frequent cylindrical to subclavate terminal cells and clamps only at the base of the basidia are diagnostic characters.

Some whitish species of *Entoloma* subgenus *Claudopus* have been recently described from Europe, but they are different from *E. alliodorum* in many aspects: *E. albotomentosum* Noordel. & Hausknecht has no smell, very distant (L = 7-10) lamellae, 4-6 angled spores, no clamps and grows in marshy habitats (NOORDELOOS & HAUSKNECHT, 1989; EBERT & al., 1992); also with white basidiomata, *E. jahnii* Wölfel & Winterh. has a poorly developed stipe, no smell, subisodiametric spores (Q = 1.15-1.45) and subcapitate terminal cells in the pellis (WÖLFEL & WINTERHOFF, 1993); *E. exiguum*, another minute species growing in ponds, was described recently from Spain by ESTEVE-RAVENTÓS & DE LA CRUZ (1998), and is characterized by the lack of smell, clamps scattered in the pileipellis and large spores with subundulating outline. *E. ollare* Ebert *et al.*, which has been included by NOORDELOOS (1994) within *Claudopus* section *Claudopus* Noordel. is basically a mesopodal species with finely encrusting pale brown pigment, which would place it in an intermediate position with respect to section *Undati* (Romagn.) Noordel.; its farinose smell would possibly back up this consideration, though some typically pleuropodal *Claudopus* species [e.g. *Entoloma byssisedum* (Pers.: Fr.) Donk] may have a floury smell too.

Species of *Claudopus* with a garlic smell have hitherto been described only from North America. MURRILL (1915) first described *C. mephiticus* from Minneapolis, based on a collection where the large size of the basidiomata (pileus 2.5-5 cm in diam.) is outstanding for a *Claudopus* species; the smell was defined as "mephytic" (= pungent, unpleasant) or garlic-like, and the rather short stipe with relation to the pileus diameter, and the greenish-white colour of the pileus when young seem diagnostic; subsequently HESLER (1967) included this species in his *Entoloma* monograph, and BARONI (1990) studied and redescribed the holotype, based on a comparative study prior to his description of *Claudopus vinaceocontusus*. The strong smell of garlic, the grey-purplish colours of the basidiomata and the presence of clamps in the context and stipitipellis are characteristic in this last species.

LARGENT (1994) has recognized two species of *Claudopus* with garlic smell from western North America: *C. mephiticus* and *C. graveolens*, this last described from California by the same author some years before (LARGENT, 1976); the smell of *C. graveolens* was described as "skunk-like" and penetrating, and other distinguishing characters are the terrestrial habitat, basidiomata of minute size, grayish-brown colours and presence of cheilocystidia. There is little doubt that the three American taxa differ in many characters from those of *E. alliodorum*.



Figs 2-4. ***Entoloma alliodorum*** (AH 16907, holotype). Fig. 2. Pileipellis with terminal cells. Fig. 3. Basidia showing clamps at the base. Fig. 4. Spores. Bar= 10 µm.

New combinations in *Entoloma*:

Entoloma vinaceocontusum (T.J. Baroni) Esteve-Rav. & A. Ortega, ***comb. nov.***
(Basionym: *Claudopus vinaceocontusus* T.J. Baroni, Mycotaxon XXXVI(2): 316, 1990)
Entoloma graveolens (Largent) Esteve-Rav. & A. Ortega, ***comb. nov.***
(Basionym: *Claudopus graveolens* Largent, Madroño 23: 376, 1976)

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A FIELD SURVEY OF THE GENUS CLADONIA (ASCOMYCOTINA) IN MANITOBA, CANADA

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ABSTRACT: Forty-seven species, two unidentified specimens, and 59 chemotypes in the genus *Cladonia* were collected in Manitoba between the years 2000 and 2002. One new record for Manitoba was *C. parasitica.* Chemical variation was evident among four members of the *C. chlorophaea* species complex, *C. chlorophaea, C. merochlorophaea, C. grayi,* and *C. cryptochlorophaea.* The *C. cariosa* group was variable in morphology and chemistry, suggesting that taxonomic research is much needed in the group. This paper is the first of a series of floristic studies that will document the lichens and their chemical variation in Manitoba beginning with the large and diverse genus *Cladonia.*

KEY WORDS: Cladoniaceae, *Cladonia parasitica, Cladonia chlorophaea, Cladonia cariosa,* chemistry

INTRODUCTION

Geographic distributions of lichen-forming fungi have been documented for North American arctic and boreal regions (Ahti 1974, Brodo *et al.* 2001, Thomson 1967, Thomson 1984), the western Canadian provinces (Brodo & Ahti 1996, Goward & Ahti 1997), and the eastern provinces (Ahti 1974, Brodo 1981). However, little is known about the lichen flora in the west central province of Manitoba. This paper provides an annotated list of species in the genus *Cladonia* P. Browne (incl. *Cladina* Nyl.), a large group of macrolichens that are ecologically dominant in large portions of Manitoba but are taxonomically difficult. Because of these taxonomic difficulties and the presence of relatively few specimens in annotated lists, distribution mapping has been problematic. Since annotated lists have collections associated with them they can be validated. The only annotated list of lichen fungi in the genus *Cladonia* from northern Manitoba is Thomson (1953) who collected 32 species of *Cladonia.* Other major works include lists that have not been annotated such as Wright (1929), Scott (1996), and a web site (see Burchill 2002), which was derived from personal collections, observations, and literature. Other species compositions were part of ecological studies (Magnusson & Stewart 1987, Ritchie 1956a, 1956b, 1956c, 1957, 1960a, 1960b, Sims & Stewart 1981, Stringer & Stringer 1974).

The province of Manitoba is one of three Prairie Provinces in Canada and covers 403,860 square kilometers with 21,390 square kilometers made up of lakes and rivers. The north west side of the province is open to Hudson Bay. The province lies between 49° and 60° N latitude and 95° and 102° W longitude. Although the province is considered part of western Canada, it is situated in the center of the country, and it contains the central meridian of Canada. Manitoba has a diversity of habitats (Shay 1984), consisting of boreal forest and tundra in the northeast corner of the province. The boreal region in Manitoba consists of mixed, northern coniferous, northern transition forest and tundra. The northern coniferous forest is underlain by Precambrian granitic rock (Canadian Shield) with little soil development. This area is dominated by white spruce (*Picea glauca* (Moench) Voss) with some jack pine (*Pinus banksiana* Lambert) or aspen (*Populus tremuloides* A. Michaux) in the well-drained areas and black spruce (*Picea mariana* (Miller) Britton, Sterns and Poggenberg) in the poorly drained areas. The southern edge of the Canadian Shield runs diagonally from north west of Lake Winnipeg, along the eastern shore of the lake, to the southeast corner of the province. The southeastern side of the Canadian Shield in Manitoba is the Whiteshell Provincial Park. South and west of Lake Winnipeg is the mixed deciduous-coniferous forest consisting of trembling aspen, white spruce and balsam poplar (*Populus balsamifera* Linnaeus) in the west, and aspen, jack pine, and white birch (*Betula papyrifera* Marshall) in the east. The glacial Lake Agassiz covered much of this region as well as further south forming glacial till and sand dunes underlain by limestone. The southeast corner of the mixed deciduous-coniferous forest is part of Sandilands Provincial Forest. This region consists of dry sandy ridges of trembling aspen, jack pine, and white birch interspersed with wetter lowlands of black spruce, larch (*Larix laricina* (Du Roi) K. Koch), white cedar (*Chamaecyparis thyoides* (Linnaeus) Britton, Sterns and Poggenberg, and black ash (*Fraxinus nigra* Marshall). Deciduous forest south of this region is dominated by aspen, white birch and white spruce, with balsam poplar in wet areas and bur oak (*Quercus macrocarpa* A. Michaux) in dry areas. Aspen parkland and prairie grassland is south west of the deciduous forest containing trembling aspen and bur oak near the deciduous forest in the north, and tall and mixed-grass prairie in the south. The province of Manitoba has a typical continental climate with cold dry winters and hot summers.

The lichen genus *Cladonia* is one of the largest genera of lichen fungi containing 500 species. Members of the genus are distributed worldwide and include two subgenera: *Cladina* and *Cladonia* (Ahti & DePriest 2001). Because of habitat diversity and the large size of Manitoba, it is expected that the province will form distribution limits for many species of *Cladonia.* The chemistry of lichen fungi in Manitoba may also be diverse especially within each species as the distribution limit is reached. In this paper I provide an annotated list of species of *Cladonia* collected in Manitoba including notes on chemistry and morphology. This paper will form the beginning of a series of studies on the lichen flora in Manitoba.

MATERIALS AND METHODS

Specimens of *Cladonia* from a variety of locations in Manitoba (Figure 1) were collected by the author between the years 2000 to 2002 and identified using morphological and chemical characters. Specimens are deposited in the University of Manitoba Herbarium (WIN) and the Canadian National Herbarium (CANL). All collection numbers are those of the author. Nomenclature follows that of Esslinger & Egan (1995). Identification keys include Brodo *et al.* (2001), Goward (1999), Stenroos (1989), and Thomson (1984). Identification of *C. parasitica* was confirmed by I. Brodo. Chemical compounds were detected by thin-layer chromatography (Culberson 1972, 1974).

RESULTS

Forty-seven species, two unidentified specimens, and 59 chemotypes of *Cladonia* were collected including some rare and new records for Manitoba. There was one new record for Manitoba, *C. parasitica,* and 14 species rarely encountered. Chemical and morphological variation was found within many species. The genus *Cladonia* in Manitoba was most widely represented by *C. amaurocraea, C. chlorophaea* complex and allies, *C. gracilis,* and some of the reindeer lichen group: *C. mitis, C. rangiferina, and C. stellaris. Cladonia multiformis* was often growing with the reindeer lichens. Specimens of *C. sulphurina* and *C. deformis* were common in mature boreal forests on the Canadian Shield.

Annotated list of species

Specimens with a single asterisk were rarely encountered in Manitoba, and the specimen with two asterisks was a new record for Manitoba.

**Cladonia acuminata* (Ach.) Norrlin. One chemotype: Norstictic acid and atranorin: Athapap Road, 5 Km south of Cranberry Portage, *1371;* North Star Road, 18 Km south of Flin Flon, *1406, 1435, 1446b;* Payuk Lake, 15 Km north of Cranberry Portage, *1311;* Wapusk National Park, 80 Km southeast of Churchill, *1762, 2088.*

C. amaurocraea (Flörke) Schaer. Two chemotypes: 1) Barbatic acid: Limestone Quarry, 20 Km north west of Cranberry Portage, *553;* Payuk Lake, 15 Km north of Cranberry Portage, *651;* Whiteshell Provincial Park, near West Hawk Lake, *462;* 2) Barbatic and usnic acid: Kisseynew Lake, 53 Km north of Cranberry Portage on Sherridon Road, *1125b, 1127, 1138a;* Nesosap Lake, 38 Km north of Cranberry Portage on Sherridon Road, *1237;* North Star Road, 18 Km south of Flin Flon, *1276;* Payuk Lake, 15 Km north of Cranberry Portage, *1115, 1118, 1148, 1296,*

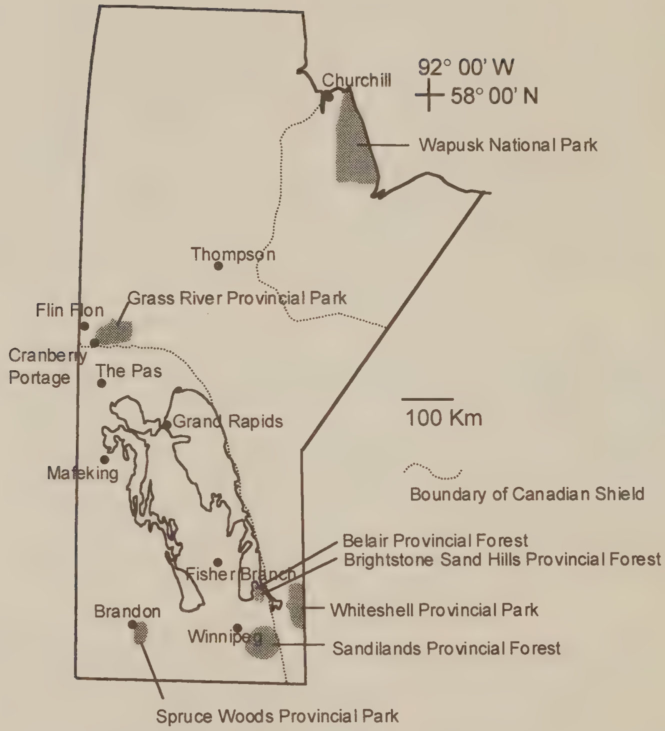
92° 00' W
58° 00' N
Churchill
Wapusk National Park
Thompson
Grass River Provincial Park
Flin Flon
Cranberry Portage
The Pas
Grand Rapids
100 Km
Mafeking
Boundary of Canadian Shield
Belair Provincial Forest
Brightstone Sand Hills Provincial Forest
Fisher Branch
Brandon
Whiteshell Provincial Park
Winnipeg
Sandilands Provincial Forest
Spruce Woods Provincial Park

Figure 1: All locations indicated on the map are those referenced in the annotated list of species. Collection sites were distributed throughout Manitoba except the extreme north west corner of the province.

1304, 1328, 651; Whiteshell Provincial Park, near West Hawk Lake, *763a, 735, 799.*
There were two chemotypes of *C. amaurocraea* in Manitoba. The major constituent was barbatic acid and the accessory was usnic acid. *Cladonia amaurocraea* was also variable in morphology. Specimens ranged from pale podetia and no cups, to greener in color with distinct cups, and pale podetia and appearing inflated like *C. uncialis*. However, the presence of barbatic acid is a distinguishing feature of *C. amaurocraea* since *C. uncialis* does not contain barbatic acid (Brodo *et al.* 2001).

**C. arbuscula* (Wallr.) Hale and Culb. One chemotype: Usnic and fumarprotocetraric acid: Wapusk National Park, 80 Km southeast of Churchill, *1718.*
Specimens of *C. arbuscula* may lack fumarprotocetraric acid (Ahti 2000). See note under *C. mitis.*

**C. bacilliformis* (Nyl.) Glück. One chemotype: Barbatic and usnic acid: Sandilands Provincial Forest, *952, 1498;* Wapusk National Park, 80 Km southeast of Churchill, *1774.*

C. borealis S. Stenroos. One chemotype: Barbatic and usnic acid: Kisseynew Lake, 53 Km north of Cranberry Portage on Sherridon Road, *1159;* North Star Road, 18 Km south of Flin Flon, *1405;* Payuk Lake, 15 Km north of Cranberry Portage, *1309, 1317;* Wapusk National Park, 80 Km southeast of Churchill, *1735, 1744, 1844;* Whiteshell Provincial Park, near West Hawk Lake, *775, 794.*
Most specimens of *C. coccifera* reported previously from Manitoba may have been *C. borealis. Cladonia borealis* was reported to contain usnic and barbatic acids and *C. coccifera* to contain usnic acid and zeorin (Stenroos 1989).

C. botrytes (K. Hagen) Willd. Three chemotypes: 1) Barbatic acid (tr.): Sandilands Provincial Forest, *970;* 2) Barbatic and usnic acid: Belair Provincial Forest, *1011;* Sandilands Provincial Forest, *951,* 3) Barbatic, usnic, and fumarprotocetraric acid (tr.) Sandilands Provincial Forest, *939.*
Although three chemotypes of *C. botrytes* were found in Manitoba, the chemotype of *C. botrytes* with usnic and barbatic acids was also reported from British Columbia (Goward 1999) and the same chemotype was reported in Brodo *et al.* (2001). Fumarprotocetraric acid has not been reported in *C. botrytes.* Although it has been reported in *C. cristatella* (Goldner *et al.* 1986) it was thought to have been derived from other lichens growing nearby (Huovinen *et al.* 1989). Specimens of *C. botrytes* found in Manitoba were morphologically similar to those of *C. cristatella* except *C. cristatella* contained larger podetia and scarlet apothecia and *C. botrytes* had smaller podetia with light brown apothecia. *Cladonia botrytes* was always found growing in mixed associations with other lichens on old logs. Some specimens of *C. botrytes* are very similar to *C. cristatella* since it is not uncommon for *C. cristatella* to lack red pigment in the apothecia.

C. cariosa (Ach.) Sprengel. Two chemotypes: 1) Atranorin: Athapap Road, 5 Km south of Cranberry Portage, *1357, 1366, 1373;* Goose Lake, 15 Km south of Cranberry Portage, *856, 859a;* Grass River Provincial Park, *825, 851, 853, 827;* Little Spruce Lake Road, 38 Km north of Cranberry Portage, *1280;* Long Point, 20 Km south of Grand Rapids, *894, 900, 910;* Marble Ridge Road, 12 Km north of Fisher Branch, *1074;* Payuk Lake, 15 Km north of Cranberry Portage, *636.* 2) Atranorin and fumarprotocetraric acid: Athapap Road, 5 Km south of Cranberry Portage, *1369;* Marble Ridge Road, 12 Km north of Fisher Branch, *1065, 1067;* Sherridon Road, 30 Km north of Cranberry Portage, *1198.*
Identification was problematic for species in the group that are closely related to *C. cariosa.* In this study the name *C. cariosa* was confined to specimens with small tongue-shaped squamules and strongly fissured podetia containing atranorin alone (Culberson 1969) or atranorin and fumarprotocetraric acid (Brodo *et al.* 2001). Despite the importance of chemistry for classification, there are three types of morphology evident in *C. cariosa sensu lato.* However, in this study chemical differences did not correspond with morphological differences. Specimens containing no podetial stalks with apothecia arising directly on the squamules are *C. apodocarpa* (not seen in this study). Other specimens contained short podetial stalks appearing inflated, sometimes found in *C. symphycarpia, C. polycarpoides,* and *C. sobolescens.* Specimens containing tall podetia with torn and fissured stalks were represented by *C. cariosa.* Ahti (2000) found little morphological variation in this group in northern Brazil.

C. cenotea (Ach.) Schaerer. One chemotype: Squamatic acid: Belair Provincial Forest, *1010b;* Kisseynew Lake, 53 Km north of Cranberry Portage on Sherridon Road, *1133;* Nesosap Lake, 38 Km north of Cranberry Portage on Sherridon Road, *1085;* Payuk Lake, 15 Km north of Cranberry Portage, *874.*

C. cervicornis subsp. *verticillata* (Hoffm.) Ahti. One chemotype: Fumarprotocetraric acid: Grass River Provincial Park, *823;* Marble Ridge Road, 12 Km north of Fisher Branch, *1055;* Sandilands Provincial Forest, *468;* Whiteshell Provincial Park, near West Hawk Lake, *744.*

C. chlorophaea (Flörke ex Sommerf.) Sprengel. One chemotype: Fumarprotocetraric acid: Bird's Hill Provincial Park, *689, 684;* Goose Lake, 15 Km south of Cranberry Portage, *855b, 868;* Grass River Provincial Park, *829, 839, 847, 850;* Little Spruce Lake Road, 38 Km north of Cranberry Portage, *1277;* Long Point, 20 Km south of Grand Rapids, *902, 905, 906;* Overflow Bay, 50 Km north of Mafeking, *509;* Marble Ridge Road, 12 Km north of Fisher Branch, *1061;* North of Gimli, *671;* Overflow Bay, 50 Km north of Mafeking, *523, 514;* Payuk Lake, 15 Km north of Cranberry Portage, *635;* Sandilands Provincial Forest, *967.*
The *C. chlorophaea* complex has been well studied in morphology, chemistry, and nucleotide sequence variation from various habitats (Ahti 1966, DePriest 1994, Culberson *et al.* 1988). In this study four members of the complex were found in

Manitoba, *C. chlorophaea, C. merochlorophaea, C. grayi,* and *C. cryptochlorophaea. Cladonia chlorophaea* contained fumarprotocetraric acid only. *Cladonia cryptochlorophaea* contained cryptochlorophaeic acid only. Two chemotypes were present for each of *C. grayi* and *C. merochlorophaea.* Some specimens of *C. grayi* contained both fumarprotocetraric and grayanic acid, while other specimens contained grayanic acid alone. Similarly, some specimens of *C. merochlorophaea* contained both fumarprotocetraric and merochlorophaeic acid, while other specimens contained merochlorophaeic acid alone.

**C. coccifera* (L.) Willd. One chemotype: Usnic acid and zeorin: Wapusk National Park, 80 Km southeast of Churchill, *1932.*
This species was rarely found in Manitoba. See note under *C. borealis.*

C. coniocraea (Flörke) Sprengel. One chemotype: Fumarprotocetraric acid: Goose Lake, 15 Km south of Cranberry Portage, *869;* Long Point, 20 Km south of Grand Rapids *907;* Marble Ridge Road, 12 Km north of Fisher Branch, *1052.*

C. cornuta (L.) Hoffm. One chemotype: Fumarprotocetraric acid: Nesosap Lake, 38 Km north of Cranberry Portage on Sherridon Road, *1081, 1083, 1103;* Payuk Lake, 15 Km north of Cranberry Portage, *887, 883, 879, 881;* Sandilands Provincial Forest, *928.*

C. crispata (Ach.) Flotow. Two chemotypes: 1) Squamatic acid: Kisseynew Lake, 53 Km north of Cranberry Portage on Sherridon Road, *1131;* Nesosap Lake, 38 Km north of Cranberry Portage on Sherridon Road, *1112,* 2) Barbatic and squamatic acid: Goose Lake, 15 Km south of Cranberry Portage, *528;* Nesosap Lake, 38 Km north of Cranberry Portage on Sherridon Road, *1104a;* Payuk Lake, 15 Km north of Cranberry Portage, *1292;* Sandilands Provincial Forest, *914, 948, 476;* Whiteshell Provincial Park, near West Hawk Lake, *802, 795.*

C. cristatella Tuck. One chemotype: Usnic and barbatic acid: Nesosap Lake, 38 Km north of Cranberry Portage on Sherridon Road, *1225;* Sandilands Provincial Forest, *922, 936;* Sherridon Road, 30 Km north of Cranberry Portage, *1168.*

**C. cryptochlorophaea* Asah. One chemotype: Cryptochlorophaeic acid. Limestone Quarry, 20 Km north west of Cranberry Portage, *549.*

**C. dahliana* Kristinsson One chemotype: Atranorin and psoromic acid: North Star Road, 18 Km south of Flin Flon, *1271;* Payuk Lake, 15 Km north of Cranberry Portage, *1342, 1344, 1403, 1405.*
The epithet *C. dahliana* refers to the chemical race of *C. symphycarpia* containing atranorin and psoromic (Goward 1999). The podetia in the specimens in this study were 18-25 mm tall and highly fissured and split to the base. The squamules were 5-10 mm long. *C. dahliana* is listed as a separate species in the North American list of species (Esslinger & Egan 1995).

**C. decorticata* (Flörke) Sprengel. One chemotype: Perlatolic acid: Belair Provincial Forest, *1023.*

C. deformis (L.) Hoffm. One chemotype: 1) Usnic acid and zeorin: Nisto Lake, 23 Km north of Cranberry Portage, *587;* Payuk Lake, 15 Km north of Cranberry Portage, *872, 876.*

C. ecmocyna subsp. *intermedia* (Robbins) Ahti. One chemotype: Fumarprotocetraric acid and atranorin: Nesosap Lake, 38 Km north of Cranberry Portage on Sherridon Road, *1087;* Sandilands Provincial Forest, *972, 973;* Wapusk National Park, 80 Km southeast of Churchill, *1707, 1904.*

C. fimbriata (L.) Fr. One chemotype: Fumarprotocetraric acid: Goose Lake, 15 Km south of Cranberry Portage, *862;* Kisseynew Lake, 53 Km north of Cranberry Portage on Sherridon Road, *1137;* Long Point, 20 Km south of Grand Rapids, *909;* Marble Ridge Road, 12 Km north of Fisher Branch, *1051, 1068;* Payuk Lake, 15 Km north of Cranberry Portage, *1326;* Whiteshell Provincial Park, near West Hawk Lake, *733, 793.*

**C. glauca* Flörke. One chemotype: Squamatic acid: Goose Lake, 15 Km south of Cranberry Portage, *534.*

C. gracilis (L.) Willd. subsp. *turbinata* (Ach.) Ahti. One chemotype: Fumarprotocetraric acid. Belair Provincial Forest, *1010a, 1018;* Goose Lake, 15 Km south of Cranberry Portage, *859b;* Grass River Provincial Park, *817, 831, 837, 840;* Kisseynew Lake, 53 Km north of Cranberry Portage on Sherridon Road, *1125a, 1126, 1134;* Limestone Quarry, 20 Km north west of Cranberry Portage, *537, 571;* Long Point, 20 Km south of Grand Rapids, *898a;* Marble Ridge Road, 12 Km north of Fisher Branch, *1053;* Nesosap Lake, 38 Km north of Cranberry Portage on Sherridon Road, *1088, 1091, 1093, 1109;* Overflow Bay, 50 Km north of Mafeking, *520;* Payuk Lake, 15 Km north of Cranberry Portage, *873, 1291, 1299;* Sandilands Provincial Forest, *929, 949, 966, 921;* Whiteshell Provincial Park, near West Hawk Lake, *731, 762, 792, 805.*

C. grayi G. Merr. ex Sandst. Two chemotypes: 1) Grayanic acid: Sandilands Provincial Forest, *930, 1499;* 2) Grayanic and fumarprotocetraric acid: Sandilands Provincial Forest, *952, 971;* Whiteshell Provincial Park, near West Hawk Lake, *448.*

C. macilenta Hoffm. One chemotype: var. *bacillaris* (Genth.) Schaerer. Barbatic acid: Belair Provincial Forest, *1015, 1019b;* Sandilands Provincial Forest, *939, 969, 918;* Whiteshell Provincial Park, near West Hawk Lake, *752.*

**C. macrophylla* (Schaerer) Stenh. One chemotype: Psoromic acid: Nisto Lake, 23 Km north of Cranberry Portage, *603, 630.*

**C. macrophyllodes* Nyl. One chemotype: Fumarprotocetraric acid and atranorin: Marble Ridge Road, 12 Km north of Fisher Branch, *1056.*

C. major (K. Hagen) Sandst. (syn. *C. fimbriata*) One chemotype: Fumarprotocetraric acid: Belair Provincial Forest, *1029;* Grass River Provincial Park, *841;* 1.5 Km North of Cranberry Portage, *1123.*
Cladonia major and *C. fimbriata,* members of the *C. chlorophaea* complex were identified as separate species in this study and in Thomson (1984). Despite the recognition of a single species (*C. fimbriata*) variable in morphology and chemistry, specimens of *C. major* and *C. fimbriata* have the same chemical constituent, fumarprotocetraric acid, but were distinguished based on morphology (Thomson 1984). Distinction between the two species was difficult where their size ranges overlapped. Although *C. major* is now recognized as a synonym of *C. fimbriata* (Esslinger & Egan 1995), the difference in size of the podetium between the two species was striking.

C. merochlorophaea Asah. Two chemotypes: 1) Merochlorophaeic acid: Belair Provincial Forest, *1012, 1022;* Wapusk National Park, 80 Km southeast of Churchill, *1937.* 2) Merochlorophaeic and fumarprotocetraric acid: Brightstone Sand Hills Provincial Forest, *1046;* Sandilands Provincial Forest, *504, 950.*

C. mitis (Sandst.) Hustich. One chemotype: Usnic acid: Belair Provincial Forest, *999, 1005;* Brightstone Sand Hills Provincial Forest, *1040;* Goose Lake, 15 Km south of Cranberry Portage, *863;* Grass River Provincial Forest, *818, 824, 844;* Limestone Quarry, 20 Km north west of Cranberry Portage, *545, 576;* Marble Ridge Road, 12 Km north of Fisher Branch, *1070, 1071;* Nesosap Lake, 38 Km north of Cranberry Portage on Sherridon Road, *1097, 1099, 1111;* Payuk Lake, 15 Km north of Cranberry Portage, *1325, 1330, 1301;* Sandilands Provincial Forest, *937,955, 981;* Spruce Woods Provincial Forest, *664;* Whiteshell Provincial Park, near West Hawk Lake, *786.*
Although *C. arbuscula* is morphologically similar to *C. mitis* and *C. rangiferina,* it was less common than *C. mitis* or *C. rangiferina* in Manitoba. The main distinction between *C. arbuscula* and *C. mitis* is chemistry. *Cladonia mitis* contains usnic acid while *C. arbuscula* contains usnic and fumarprotocetraric acids. Some of the usnic acid containing *C. mitis* specimens were morphologically more similar to *C. arbuscula,* but lacked fumarprotocetraric acid, and therefore were classified as *C. mitis.*

C. multiformis G. Merr. One chemotype: Fumarprotocetraric acid: Belair Provincial Forest, *1000;* Goose Lake, 15 Km south of Cranberry Portage, *864, 867;* Grass River Provincial Forest, *816, 854, 820;* Long Point, 20 Km south of Grand Rapids, *897, 899, 904;* Marble Ridge Road, 12 Km north of Fisher Branch, *1063, 1072;*

Payuk Lake, 15 Km north of Cranberry Portage, *1117, 886, 888;* Sandilands Provincial Forest, *978, 926, 934, 940, 944, 957, 980;* Whiteshell Provincial Park, near West Hawk Lake, *734, 791.*

** *C. parasitica* (Hoffm.) Hoffm. One chemotype: Thamnolic and barbatic acid: Whiteshell Provincial Park, near West Hawk Lake, *450.*

C. phyllophora Hoffm. One chemotype: Fumarprotocetraric acid: Brightstone Sand Hills Provincial Forest, *1034, 1050;* Limestone Quarry, 20 Km north west of Cranberry Portage, *568;* Payuk Lake, 15 Km north of Cranberry Portage, *1295;* Sandilands Provincial Forest, *915, 932;* Whiteshell Provincial Park, near West Hawk Lake, *761, 767, 769.*
Cladonia phyllophora is common throughout Manitoba. Since none of the specimens contained atranorin they were placed in *C. phyllophora.* However, morphology of some of these specimens matched the description for *C. stricta* (Nyl.) Nyl, which contains both fumarprotocetraric acid and atranorin.

C. pleurota (Flörke) Schaer. Two chemotypes: 1) Usnic acid: Nesosap Lake, 38 Km north of Cranberry Portage on Sherridon Road, *1108,* 2) usnic acid and zeorin: Payuk Lake, 15 Km north of Cranberry Portage, *878;* Wapusk National Park, 80 Km southeast of Churchill, *1858, 1921.*

C. pocillum (Ach.) Grognot. One chemotype: Fumarprotocetraric acid and atranorin: Marble Ridge Road, 12 Km north of Fisher Branch, *1058, 1059.*

C. pyxidata (L.) Hoffm. One chemotype: Fumarprotocetraric acid: Brightstone Sand Hills Provincial Forest, *1038, 1041, 1043;* Goose Lake, 15 Km south of Cranberry Portage, *861;* Grass River Provincial Park, *842, 838;* Long Point, 20 Km south of Grand Rapids, *908;* Sandilands Provincial Forest, *477, 974, 968;* Spruce Woods Provincial Forest, *670.5;* Whiteshell Provincial Park, near West Hawk Lake, *736, 774.*

C. rangiferina (L.) Nyl. One chemotype: Fumarprotocetraric acid, atranorin: Belair Provincial Forest, *998, 1004;* Goose Lake, 15 Km south of Cranberry Portage, *860;* Grass River Provincial Park, *855a;* Kisseynew Lake, 53 Km north of Cranberry Portage on Sherridon Road, *1128, 1139;* Long Point, 20 Km south of Grand Rapids, *911, 895b;* Marble Ridge Road, 12 Km north of Fisher Branch, *1073;* Nesosap Lake, 38 Km north of Cranberry Portage on Sherridon Road, *1098*; Payuk Lake, 15 Km north of Cranberry Portage, *1116, 1300;* Sandilands Provincial Forest, *498, 493, 924, 959, 942, 976, 979;* Whiteshell Provincial Park, near West Hawk Lake, *737, 763b, 801, 741, 784, 804.*

C. scabriuscula (Delise) Nyl. One chemotype: Fumarprotocetraric acid: Bird's Hill Provincial Park, *681;* Overflow Bay, 50 Km north of Mafeking, *519, 521;* Payuk Lake, 15 Km north of Cranberry Portage, *882.*

**C. squamosa* Hoffm. One chemotype: Squamatic acid: 1.5 Km North of Cranberry Portage, *1122*.

C. stellaris (Opiz) Pouzar & Vezda. Two chemotypes: 1) Usnic acid: Grass River Provincial Park, *843,* 2) Usnic and perlatolic acid: Belair Provincial Forest, *1026;* Kisseynew Lake, 53 Km north of Cranberry Portage on Sherridon Road, *1143, 1144, 1135;* Long Point, 20 Km south of Grand Rapids, *912, 895a;* Nesosap Lake, 38 Km north of Cranberry Portage on Sherridon Road, *1089, 1114;* Whiteshell Provincial Park, near West Hawk Lake, *770, 790, 812*.

**C. stygia* (Fr.) Ahti. Two chemotypes: 1) Atranorin and fumarprotocetraric acid: Wapusk National Park, 80 Km southeast of Churchill, *1839, 1939, 1943*. 2) Atranorin: Wapusk National Park, 80 Km southeast of Churchill, *1841, 1947*. *Cladonia stygia* was rare in Manitoba found only in Wapusk National Park.

**C. subfurcata* (Nyl.) Arnold. One chemotype: Squamatic acid: Whiteshell Provincial Park, near West Hawk Lake, *457*.

C. subulata (L.) F. H. Wigg. One chemotype: Fumarprotocetraric acid: Nesosap Lake, 38 Km north of Cranberry Portage on Sherridon Road, *1227;* North Star Road, 18 Km south of Flin Flon, *1270;* Payak Lake, 15 Km north of Cranberry Portage, *1313;* Sandilands Provincial Forest, *503;* Whiteshell Provincial Park, near West Hawk Lake, *1508, 1520*.

C. sulphurina (Michaux) Fr. One chemotype: Usnic and squamatic acid: Nesosap Lake, 38 Km north of Cranberry Portage on Sherridon Road, *1092, 1086, 1104b, 1105;* Payuk Lake, 15 Km north of Cranberry Portage, *877*.

**C. symphycarpia* (Flörke) Fr. One chemotype: Atranorin: Payuk Lake, 15 Km north of Cranberry Portage, *1395*.
Although Brodo *et al.* (2001) listed three chemotypes, and Ahti (2000) listed two different chemotypes, only one chemotype was found in Manitoba. Specimens of *C. symphycarpia* were identified based on the large, thick, squamules and chemistry (Ahti 2000). The chemical race of *C. symphycarpia* containing atranorin and psoromic acid was referred to as *C. dahliana* (Goward 1999).

C. turgida Hoffm. One chemotype: Atranorin and fumarprotocetraric acid: Whiteshell Provincial Park, near West Hawk Lake, *458, 461, 758, 766, 772b, 780, 787, 789, 800*.
Although both *C. turgida* and *C. symphycarpia* are present in Brodo *et al.* (2001), they were not included in Thomson (1953, 1984) for Manitoba. Their occurrence in Manitoba was not unexpected since their distributions are circumpolar and arctic to temperate. The detection of *C. symphycarpia* in the past may have been overlooked since none of the specimens in this study contained podetia. Although specimens of

C. turgida were constant in chemistry, they were variable in morphology. Some specimens consisted of sterile squamules containing few short fruiting structures, and some consisted of well-developed podetia 4-6 cm tall arising from the disappearing basal squamules.

C. uncialis (L.) F. H. Wigg. One chemotype: Usnic acid: Belair Provincial Forest, *997, 1002, 1025;* Nesosap Lake, 38 Km north of Cranberry Portage on Sherridon Road, *1100, 1101;* Sandilands Provincial Forest, *931, 953, 977;* Whiteshell Provincial Park, near West Hawk Lake, *746, 782, 806, 732, 807.*

Unknown species

Cladonia specimen #1. Fumarprotocetraric acid: North Star Road, *1274;* Sherridon Road, 36 Km north of Cranberry Portage, *1169.* These specimens were thought to be *C. chlorophaea* except many of the podetial cups were proliferating from within older cups, and the cup and sides of the podetium were often split.

Cladonia specimen # 2. Atranorin, norstictic and fumarprotocetraric acid: Athapap Road, 5 Km south of Cranberry Portage, *1345.* This specimen was thought to be part of the *C. cariosa* group with small squamules and fissured podetia containing brown apothecia. It was growing in an open forest with limestone rock emerging from soil on an old piece of charred wood. The area was aspen dominated with some white spruce and jack pine. Since the morphology of the specimen from Manitoba was similar to descriptions of *C. peziziformis* (With.) J. R. Laundon (Ahti 2000), it may be a chemical variant of *C. peziziformis* with fumarprotocetraric acid and atranorin being the constant constituents of the species and norstictic acid being an accessory compound. The chemistry is also similar to that reported for the 'III = *C. polycarpoides*' chemotype of the *C. subcariosa* group (Ahti 2000). However, the squamules of *C. subcariosa* are much larger than those in specimen *1345.*

Additional species reported as occurring in Manitoba (Brodo *et al.* 2001, Thomson 1984) that were not collected during this study:
C. alaskana A. Evans
C. carneola (Fr.) Fr.
C. cyanipes (Sommerf.) Nyl.
C. digitata (L.) Hoffm.
C. maxima (Asah.) Ahti
C. pseudorangiformis Asah. (= *C. wainioi* Savicz)
C. rei Schaerer
C. stricta (Nyl.) Nyl.
C. trassii Ahti

DISCUSSION

In this study the number of species of *Cladonia* was two less than the number in Thomson (1984) and exceeded those found in Thomson (1953) and Brodo *et al.* (2001). However, three species from Thomson (1953) were not found during this study (*C. brevis, C. carneola,* and *C. subcervicornis*). *Cladonia brevis* would be readily recognized by TLC since it contains psoromic acid. *Cladonia carneola* is a northern circumboreal and arctic species and would be recognized by having brown apothecia and chemistry typical of the red-fruited species (Brodo *et al.* 2001). Specimens of *C. subcervicornis* are considered to be misidentified in North America and are found in Greenland (Esslinger & Egan 1995). Four species listed by Brodo *et al.* (2001) were not collected in this study (*C. bellidiflora, C. carneola, C. rei,* and *C. trassii*). *Cladonia bellidiflora* and *C. carneola* are uncommon in Manitoba. Although *C. rei* is reported to be common (Brodo *et al.* 2001) it was not found in this study. *Cladonia rei* can be readily recognized by TLC since it contains homosekikaic acid. *Cladonia stricta* and *C. trassii* are less common and grow in late snowbank areas in the tundra, a site not visited during this study. Although *C. stricta* and *C. trassii* are very similar in morphology (Ahti 1998) and may be mistaken for *C. phyllophora,* they contain atranorin whereas *C. phyllophora* does not contain atranorin.

Two major species lists that were both collection based and compilations of the literature were Brodo *et al.* (2001) and Thomson (1984). Distribution maps of 48 species of *Cladonia* in Thomson (1984) showed collection localities within Manitoba. Nine of those species were not collected in this study. However, four species collected in this study were not part of Thomson's (1984) list. Thirteen species reported in this study were not listed in Brodo *et al.* (2001). All 13 species were not common in Manitoba. Discrepancies were due to nomenclatural changes, chemistry, or geographic areas not visited. Based on Brodo *et al.* (2001), Thomson (1953), and Thomson (1984) there was one new record for Manitoba and 14 species rarely encountered.

Limited collections from Manitoba in the past may account for the new and rare records reported in this study. This study is the second collection based list of lichen species for Manitoba and one of the few annotated lists that includes chemical information. Continued collection of *Cladonia* as well as other genera of lichen-forming fungi in the central Canadian provinces is critical to complete the distribution maps for lichens of North America. Chemical and morphological variation is evident within species in this study and may represent microhabitat changes. Further study is required to examine geographic, microhabitat, or morphological correlation with chemical variation.

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A FIRST CHECK-LIST OF PERONOSPORACEAE FROM KOREA

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ABSTRACT: Some 353 specimens belonging to 29 species of Peronosporaceae have been collected during recent years. Most of these are new to Korea. Each species is accompanied by a short description and taxonomic notes. Seven species of downy mildews, previously recorded in Korea but not collected by the authors, were also added. This provisional compilation is the first step towards a monograph of Peronosporaceae of Korea.

Keywords: *Bremia*, *Hyaloperonospora*, *Paraperonospora*, *Perofascia*, *Peronospora*, *Plasmopara*, *Pseudoperonospora*, *Sclerophthora*, *Sclerospora*, downy mildew, plant pathogenic fungi, biogeography

Flora of plant pathogenic fungi of Korea is poorly known. These fungi have been recorded mainly on cultivated plants, but monographic studies on major groups are a rather recent concern. Up to now, three monographs, viz. Erysiphaceae (Shin, 2000), *Alternaria* and *Stemphylium* (Yu, 2001), and *Cercospora* and allied genera (Shin and Kim, 2001), have been published. Monographic studies on the other important phytopathogenic fungi are urgently needed.

Peronosporaceae is one of the most studied groups of plant pathogenic fungi. Monographs or list regarding the national territories of most European countries, as well as of the countries once part of the Soviet Union have been published. For East Asia a monograph of Peronosporales of China was recently published (Yu *et al*., 1998).

The downy mildew fungi (Peronosporaceae) of Korea are insufficiently known and not yet intensively studied. Only thirty-eight fungus/host combinations have been recorded up to now (The Korean Society of Plant Pathology, 1998). Most of earlier literature records regarding the Peronosporaceae of Korea contain insufficient information on morphological characteristics of the fungi involved. Moreover, no herbarium specimens have been preserved. The senior author started in 1988 to collect downy mildew fungi from various localities of Korea, and the second author joined field excursions from 2002. The microscopic examination and identification of these collections were carried out jointly.

The present paper lists the downy mildew fungi collected and identified by the authors from 1988 to 2002. Short descriptions and taxonomic notes are added. The host plants not reported previously as host for downy mildews of Korea are preceded by an asterisk. Germination was carried out by placing fresh conidia/sporangia on a drop of distilled water on a glass slide and incubating in humid chamber at 15°C, and examined every two hours. The specimens are preserved in the herbarium SMK (Herbarium of Systematic Mycology, Korea University, Seoul, Korea), and the accession number is indicated between parentheses.

LIST OF SPECIES IDENTIFIED

Bremia lactucae Regel

Conidiophores hyaline, 230-640 μm long, trunk straight, 7.5-10 μm wide, base not or only slightly swollen; upper part dichotomously branched 4-5(-6) times; branch tips swollen into an inverted drum-shaped vesicle (6-12 μm diam.) bearing 3-5 extensions; callose plugs present at the lower part of the trunk. Conidia hyaline to subhyaline, globose to subglobose, 14-21 × 14-19 μm (length/width = 0.9-1.2), very shortly pedicellate, having thin-walled papilla; when germinating produces germ tubes through papilla. Oospores not seen.

On **Lactuca indica* var. *laciniata* (Kuntze) Hara – Chunchon, 28 VI 2002 (18913); Kangnung, 16 XI 1990 (10698); ditto, 16 XI 1990 (10701); ditto, 4 VI 1994 (12835); ditto, 19 VI 1995 (13559); ditto, 23 VI 1995 (13586); ditto, 27 VI 1995 (13597); Namyangju, 30 V 1998 (14571); ditto, 6 VI 2000 (17397). On **Lactuca indica* forma *indivisa* Hara – Chunchon, 1 V 2002 (18823). On *Lactuca sativa* L. – Busan, 23 XI 2002 (19415); Kangnung, 13 X 1993 (12697); Namyangju, 10 IV 2001 (18188); ditto, 9 V 2001 (18193); ditto, 18 V 2002 (18853); Pyongchang, 30 VII 1993 (12484); ditto, 27 IX 2002 (19108).

Note: This species was recorded on *Lactuca sativa* by Park (1961) for the first time in Korea. The morphology of specimens originating from these two hosts were very similar, except that the length/width ratio of the conidia from *Lactuca indica* var. *laciniata* was 0.9 to 1.1, whereas that from *L. sativa* ranged from 1.0 to 1.2. Though apical papilla was described as having slightly thickened wall (Morgan, 1981), the conidia in our collections showed thinner wall at papilla compared to other part of conidia.

Hyaloperonospora parasitica **(Pers. : Fr.) Constant.**

Conidiophores hyaline, 120-800 µm long, trunk straight, 7.5-19 µm wide, base not or somewhat swollen; upper part monopodially or subdichotomously branched 3-5(-7) times; ultimate branchlets flexuous to curved, 10-15 µm long, 1.5-3 µm wide at the base and becoming narrower upwards, apex obtuse. Conidia hyaline to subhyaline, subglobose to ovoidal, 20-30 × 17.5-25 µm (l/w = 1.1-1.3(-1.4)), not protruding at the base, producing germ tubes at randomly located sites. Oospores not seen.

On *Arabis glabra* (L.) Bernh. – Kangnung, 16 VI 1995 (13558). On **Armoracia lapathifolia* Gilib. – Namyangju, 10 IV 2001 (18191). On **Barbarea orthoceras* Ledeb. – Dongduchon, 9 X 2000 (17785). On **Brassica campestris* var. *nippo-oleifera* Makino – Kangnung, 25 X 1994 (13212). On *Brassica campestris* var. *pekinensis* Makino – Kangnung, 29 X 1996 (13731); Seoul, 17 VI 1999 (16040); Suwon, 5 IX 2000 (17506); Yongin, 30 IX 1993 (12651). On *Brassica juncea* var. *integrifolia* Sinsk. – Namyangju, 28 X 1998 (15605). On *Capsella bursa-pastoris* (L.) Medicus – Busan, 23 XI 2002 (19418); Chunchon, 2 XI 1991 (11441); ditto, 27 V 1994 (12789); ditto, 13 V 1999 (15789); ditto, 1 V 2002 (18820); Donghae, 21 V 1995 (13493); Euijongbu, 26 IV 1999 (15695); Hongchon, 18 V 2000 (17324); ditto, 10 V 2002 (18835); ditto, 11 X 2002 (19254); Kangnung, 12 IV 1991 (10713); ditto, 6 XI 1991 (11470); ditto, 23 IV 1994 (12758); Samchok, 6 VI 2002 (18890); Seoul, 2 V 1997 (13745); ditto, 31 V 1997 (13864); ditto, 27 IV 1998 (14486); ditto, 24 IV 1999 (15691); Yongin, 28 IV 2000 (17257). On **Cardamine flexuosa* With. – Chunchon, 1 V 2002 (18819); Kangnung, 9 V 1993 (12389). On **Cardamine leucantha* O. E. Schulz – Chunchon, 5 V 1998 (14493); ditto, 2 V 1999 (15723); ditto, 13 V 1999 (15795); ditto, 4 V 2000 (17273); ditto, 11 X 2002 (19216); Dongduchon, 2 VI 2000 (17378); Gapyong, 2 V 1999 (15728); Hongchon, 18 V 2000 (17322); Kangnung, 1 VI 1994 (12812); ditto, 8 V 1995 (13469); ditto, 12 V 2000 (17298); ditto, 6 V 1999 (15766); ditto, 5 X 2001 (18539); Pyongchang, 6 V 1999 (15771); Samchok, 5 V 1999 (15746); ditto, 11 V 2000 (17276); Yangku, 23 V 1999 (15847). On **Cardamine scutata* Thunb. – Chunchon, 1 V 2002 (18833). On **Draba nemorosa* var. *hebecarpa* Lindeb. – Chunchon, 27 IV 1994 (12760); ditto, 2 V 1999 (15718); ditto, 4 V 2000 (17270); ditto, 1 V 2002 (18831); Hongchon, 18 V 2000 (17319); ditto, 10 V 2002 (18842); ditto, 11 X 2002 (19249); Suwon, 22 IV 2002 (18811); Yangpyong, 16 X 2002 (19270). On *Raphanus sativus* forma *acanthiformis*

Makino – Chunchon, 5 X 1998 (15363); ditto, 7 XI 2000 (18076); Guri, 29 X 1997 (14463); Jeju, 2 XI 2002 (19363); Kangnung, 25 X 1994 (13198); ditto, 25 X 1994 (13210); Namyangju, 30 IX 1997 (14315); ditto, 28 X 1998 (15604); ditto, 8 X 1997 (14390); ditto, 28 X 1998 (15609). On **Rorippa cantoniensis* Ohwi – Chunchon, 29 X 1994 (13263). On **Rorippa islandica* (Oed.) Borb. – Busan, 23 XI 2002 (19420); Chunchon, 24 V 1992 (11603); ditto, 11 X 2002 (19207); Cheongju, 15 X 1999 (17090); Hoengseong, 6 V 1999 (15779); Jeju, 2 XI 2002 (19362); Jinju, 30 X 2000 (18014); Kangnung, 19 VIII 1989 (10189); ditto, 27 X 1991 (11409); ditto, 6 XI 1991 (11471); ditto, 29 V 1994 (12798); ditto, 25 X 1994 (13218); Namyangju, 30 V 1998 (14575); ditto, 28 X 1998 (15602); ditto, 28 V 1999 (15883); ditto, 6 VI 2000 (17401); ditto, 24 X 2001 (18713); ditto, 18 V 2002 (18859); Pyongchang, 22 VI 1995 (13580); ditto, 6 VI 2002 (18881); Suwon, 28 IV 1988 (10104); ditto, 4 X 1999 (16953). On **Thlaspi arvense* L. – Chunchon, 4 V 2000 (17271); ditto, 1 V 2002 (18832).

Note: Nakata and Takimoto (1928) were first to record this species in Korea, on *Brassica campestris* var. *pekinensis*. Additional records were made by Park (1958) on *Arabis glabra* and *Raphanus sativus* forma *acanthiformis*, by Shin and Kim (1997) on *Capsella bursa-pastoris*, and by Cho *et al*. (1997) on *Brassica juncea* var. *integrifolia* and *B. rapa*.

The above description is based on the materials from *C. bursa-pastoris*, which is the typical host of this fungus (Constantinescu and Fatehi, 2002). Although the morphological characteristics of the fungi from the above hosts were similar each other and not at variance with the previous records of this species, the size of the conidiophores and conidia originating from different genera and/or species of hosts were more or less variable. Similar variation was previously described by several authors (Gäumann, 1923; Gustavsson, 1959; Yerkes and Shaw, 1959). Phylogenetic analysis of the ITS rDNA sequences from the above-listed Korean collections showed a high divergence among isolates derived from various host genera or species, suggesting that *H. parasitica* complex possibly consists of several distinct taxa (Choi *et al*., unpublished data).

***Paraperonospora chrysanthemi-coronarii* (Sawada) Constant.**

Conidiophores hyaline, 400-820 µm long, trunk straight, 10-15 µm wide, base not or somewhat swollen; upper part monopodially or subdichotomously branched 4-6(-7) times, occasionally trichotomous; branches often becoming broader upwards; ultimate branchlets substraight to slightly curved, 6-13 µm long, 2-4 µm wide at the base and becoming gradually tapered upwards, apex rounded or slightly swollen; callose plugs present at the trunk and the higher order branches. Conidia subhyaline, broadly ellipsoidal to ellipsoidal, variable in size, 27-48 × 17.5-25 µm (l/w = 1.5-2.1), shortly pedicellate. Oospores not seen.

On *Chrysanthemum coronarium* var. *spatiosum* Bailey – Namyangju, 30 VIII 1998 (14976).

Note: This fungus was firstly recorded in Korea by Lee (1979) under *Peronospora chrysanthemi-coronarii* (Sawada) S. Ito & Y. Tokunaga. A closely related species, parasitic on the same host, is *Paraperonospora multiformis* (Tao & Y. Qin) Constant. It differs from *P. chrysanthemi-coronàrii* mainly by its smaller conidia (Constantinescu, 1989; Tao, 1998).

Our collection on *C. coronarium* var. *spatiosum*, which is an important vegetable crop in Korea, Japan, China, and Taiwan, had intermediate characters between *P. chrysanthemi-coronarii* and *P. multiformis*, and we suppose that these two species may be conspecific.

***Perofascia lepidii* (McAlpine) Constant.**

Conidiophores hyaline to subhyaline, 110-300 µm long, trunk straight to slightly curved, 5-8 µm wide, base not or somewhat swollen; upper part pseudodichotomously branched 3-4(-5) times; branches appressed, sometimes parallel. Conidia subhyaline, broadly ellipsoidal to ellipsoidal, 19-34 × 16-24 µm (l/w = 1.3-1.65), slightly protruding at the base. Oospores not seen.

On *Lepidium apetalum* Willd. – Koyang, 11 IV 1999 (15682); Namyangju, 28 V 1999 (15893); Nonsan, 26 IV 1998 (14475); Seoul, 2 V 1997 (13746); ditto, 24 IV 1999 (15690). On *Lepidium virginicum* L. – Seoul, 25 IV 2000 (17250); ditto, 15 V 2000 (17311).

Note: This is the first record of this fungus from Korea. The genus *Perofascia* Constant. was recently segregated from *Peronospora* by Constantinescu and Fatehi (2002), based on phenetic characters and molecular data. Our microscopic observations and rDNA sequence analysis (Choi *et al.*, unpublished data) of the Korean collections were consistent with the result of their investigation.

***Peronospora alta* Fuckel**

Conidiophores subhyaline, 220-650(-950) µm long, trunk straight, 7-10 µm wide, base not or somewhat swollen; upper part monopodially branched 5-6(-7) times, occasionally appearing subdichotomous; ultimate branchlets flexuous to curved, 5-20 µm long, ca. 2 µm wide at the base and becoming narrower upwards, apex obtuse. Conidia olivaceous to pale brown, broadly ellipsoidal to ellipsoidal, 23-33 × 19-23 µm (l/w = 1.2-1.5), not or slightly protruding at the base, producing germ tubes at randomly located sites. Oospores not seen.

On *Plantago asiatica* L. – Pochon, 25 V 2000 (17359); Yangku, 1 XI 1998 (15620). On *Plantago camtschatica* Cham. – Chunchon, 11 X 2002 (19209). On *Plantago lanceolata* L. – Chunchon, 5 VI 1998 (14605).

Note: This is the first record of this species from Korea. No specific germination site on the conidia could be detected. Prior to germination the conidia became swollen and reached ca. 30 µm wide, appearing globose to subglobose.

Peronospora astragalina **H. Sydow**

Conidiophores hyaline to subhyaline, 160-420 µm long, trunk straight, 5-9 µm wide, base not or somewhat swollen; upper part dichotomously branched 5-6(-7) times, ultimate branchlets becoming tapered upwards, giving a rather stiff appearance. Conidia pale brownish, variable in shape and l/w ratio, broadly ellipsoidal to subglobose or broadly obovoidal, 17.5-30 × 12.5-24 µm (l/w = 1.1-1.5), not or slightly protruding at the base, producing germ tubes laterally. Oospores not seen.

On *Astragalus membranaceus* Bunge – Samchok, 26 V 1997 (13840); ditto, 5 V 1999 (15736); ditto, 10 V 2001 (18200).

Note: The downy mildew fungus on *Astragalus membranaceus* was recorded by Ryu *et al*. (2001) for the first time in Korea under *Peronospora trifoliorum* de Bary. The description and illustrations provided by these authors are very similar to the characters of our collection. However, we prefer to identify this species as *Peronospora astragalina.* The germination of conidia in most *Peronospora* species was known to occur anywhere on the circumference of the spore. The conidia of this fungus always germinated by producing a germ tube laterally.

Peronospora campestris **Gäum.**

Conidiophores hyaline to subhyaline, 220-500 µm long, trunk straight, 9-11 µm wide, base not or somewhat swollen; upper part dichotomously branched 7-9(-10) times. Conidia pale olivaceous, broadly ellipsoidal to subglobose, 15-21 × 12.5-17.5 µm (l/w = 1.15-1.35), not or very slightly protruding at the base, producing germ tubes at randomly located sites. Oospores not seen.

On **Arenaria serpyllifolia* L. – Chunchon, 4 V 2000 (17264); Hongchon, 18 V 2000 (17334); Kangnung, 11 V 2001 (18203); Yangpyong, 16 X 2002 (19269).

Note: This is the first record of this species from Korea. *Peronospora campestris* is a cosmopolitan species and the only downy mildew fungus known on *Arenaria* (Constantinescu, 1991). The characters of our collection agreed with the descriptions provided by Gustavsson (1959), Kochman and Majewski (1970), and Yu *et al*. (1998). The conidiophores of our collection were profusely, dichotomously, 7-10 times branched, which seems to be characteristic for this species.

Peronospora chelidonii **Miyabe ex A.A. & P.A. Jaczewski**

Conidiophores hyaline to subhyaline, 130-280 µm long, trunk straight to substraight, 5-9 µm wide, base not or somewhat swollen; upper part dichotomously branched 4-5(-6) times, occasionally subdichotomous or trichotomous; ultimate branchlets substraight to slightly curved, 6-13 µm long, 2-4 µm wide at the base and becoming narrower upwards, apex mostly obtuse, rarely subtruncate. Conidia pale olivaceous to olivaceous, subglobose to broadly ellipsoidal, 18-23 × 16-21 µm (l/w = 1.05-1.2(-1.4)), not protruding at the base, producing germ tubes laterally. Oospores spherical, brown to dark brown, 35-45 µm diam.

On **Chelidonium majus* var. *asiaticum* (Hara) Ohwi – Chunchon, 14 V 1994 (12762); ditto, 27 V 1995 (13510); ditto, 5 V 1998 (14492); ditto, 13 V 1999 (15792); ditto, 4 V 2000 (17267); ditto, 1 V 2002 (18825); ditto, 11 X 2002 (19195); Dongduchon, 2 VI 2000 (17385); ditto, 9 X 2000 (17809); Euijongbu, 26 IV 1999 (15693); Gapyong, 2 V 1999 (15726); Hoengseong, 6 V 1999 (15877); Hongchon, 18 V 2000 (17321); ditto, 10 V 2002 (18848); Namyangju, 25 V 1997 (13806); Pyongchang, 6 VI 1995 (13513); ditto, 6 VI 1995 (13517); ditto, 6 V 1999 (15775); ditto, 6 VI 2002 (18882); Samchok, 5 V 1999 (15755); ditto, 11 V 2000 (17281); Seoul, 8 VI 1997 (13942); ditto, 3 V 1998 (14488); ditto, 19 V 2002 (18867); ditto, 13 V 2000 (17307); Yangku, 23 V 1999 (15842).

Note: This is the first record of this species from Korea. For a detailed discussion, see the note under *Peronospora corydalis*.

Peronospora corydalis **de Bary**

Conidiophores hyaline to subhyaline, 140-240 µm long, trunk straight, 7-10 µm wide, base not or somewhat swollen; upper part dichotomously branched 4-6 times, occasionally subdichotomous or trichotomous. Conidia pale olivaceous to olivaceous, subglobose to broadly ellipsoidal, 19-26 × 17.5-23 µm (l/w = 1.05-1.3), not protruding or having a scar of attachment at the base. Oospores spherical, golden brown, 35-48 µm diam.

On **Corydalis ochotensis* Turcz. – Chunchon, 4 V 2000 (17268); ditto, 1 V 2002 (18821); ditto, 11 X 2002 (19218); Dongduchon, 2 VI 2000 (17368); ditto, 9 X 2000 (17810); Hongchon, 18 V 2000 (17331); ditto, 10 V 2002 (18846); Pyongchang, 6 VII 1999 (16231); ditto, 12 V 2000 (17301); ditto, 10 VI 2000 (17423); Wonju, 18 X 2002 (19280). On **Corydalis speciosa* Max. – Gapyong, 2 V 1999 (15729); Hongchon, 10 V 2002 (18839); Yangku, 23 V 1999 (15846). On **Corydalis turtschaninovii* Bess. – Hongchon, 18 V 2000 (17328); Samchok, 11 V 2000 (17277).

Note: This is the first record of this species from Korea. Eighteen species of *Peronospora* Corda have been described on eleven genera of Papaveraceae

(Constantinescu, 1991). We have collected *Peronospora* spp. on four host genera: *Chelidonium*, *Corydalis*, *Dicentra*, and *Hylomecon*. Separate *Peronospora* species have been described on these hosts, viz. *P. chelidonii*, *P. corydalis*, *P. dicentrae*, and *P. hylomeconis* (Constantinescu, 1991). In addition, on *Corydalis*, two additional species, *P. bulbocapni* and *P. corydalis-intermediae*, were described, but these were treated as conspecific with *P. corydalis* (Yu *et al.*, 1998).

The microscopic examination of our collections on these four host genera revealed that they are similar, though the specimens on *Hylomecon vernale* have longer conidiophores. Molecular data of rDNA sequence from these four morphological species suggested that they are indeed conspecific (Choi *et al.*, unpublished data).

Peronospora destructor (Berk.) Casp. ex Berk.

Conidiophores hyaline to subhyaline, 140-230 μm long, trunk straight, 25-30 μm wide, base not or somewhat swollen; upper part monopodially or subdichotomously branched 3-5(-6) times; ultimate branchlets substraight to slightly curved, apex subtruncate. Conidia pale brownish to brown, obovoidal or pyriform, 40-56 × 21-27.5 μm (l/w = 1.75-2.15), becoming narrower toward the base, and provided with a pedicel-like protuberance. Oospores not seen.

On *Allium fistulosum* L. – Kangnung, 23 XI 1991 (11563); Samchok, 5 V 1999 (15742). On **Allium tuberosum* Roth. – Chunchon, 2 XI 1991 (11437).

Note: *Peronospora destructor* was first recorded in Korea by Nakata and Takimoto (1928) on *Allium fistulosum*, and later by Park (1958) on *A. cepa*. The downy mildew disease of *A. cepa* associated with this fungus produced severe economic damage in the southern part of Korea in May 2002. The apex of ultimate branchlets was subtruncate, which seems to be characteristic for this species.

Peronospora dicentrae H. Sydow

Conidiophores hyaline to subhyaline, 160-280 μm long, trunk straight to substraight, 7.5-10 μm wide, base not or somewhat swollen; upper part dichotomously branched 5-6 times, occasionally subdichotomous or trichotomous. Conidia pale olivaceous to olivaceous, subglobose to broadly ellipsoidal, 17.5-24 × 16-20 μm (l/w = 1.1-1.4), not protruding at the base. Oospores not seen.

On **Dicentra spectabilis* (L.) Lem. – Pyongchang, 10 VI 2000 (17418); ditto, 6 VI 2002 (18877).

Note: This is the first record of this species from Korea. For a detailed discussion, see the note under *Peronospora corydalis*.

Peronospora ducometii Siem. & Jank.

Conidiophores hyaline to subhyaline, 320-540 µm long, trunk straight, 6-10 µm wide, base not or somewhat swollen; upper part dichotomously branched 6-7(-8) times. Conidia olivaceous, broadly ellipsoidal to ellipsoidal, 20-32 × 15-18 µm (l/w = 1.3-1.8), protruding at the base. Oospores not seen.

On *Fagopyrum esculentum* Moench. – Suwon, 29 VI 1998 (14690).

Note: This fungus was recorded for the first time in Korea by Park (1958) but without a description. In previous descriptions, the range of conidia dimensions is rather narrow: 23-25 × 15-16 µm in Kochman and Majewski (1970), and 16-21 x 14-18 µm in Yu *et al.* (1998). The conidia of our collection were rather variable in length, resulting a wider range of length, width and l/w values.

Peronospora farinosa (Fr.) Fr.

Conidiophores hyaline to subhyaline, 240-580 µm long, trunk straight, 7.5-10 µm wide, base not or somewhat swollen; upper part dichotomously branched 5-6(-7) times. Conidia olivaceous with a grayish tint, obovate to broadly ellipsoidal, 24-35 × 22-26 µm (l/w = 1.2-1.35), shortly pedicellate, producing germ tubes laterally. Oospores spherical, golden brown to brown, 22-33 µm diam.

On **Chenopodium album* var. *centrorubrum* Makino – Chunchon, 2 V 1999 (15722); ditto, 4 V 2000 (17266); ditto, 12 IX 2000 (17547); ditto, 1 V 2002 (18830); Kangnung, 31 X 1994 (13292); Pyongchang, 3 X 2000 (17768); Samchok, 5 V 1999 (15765); ditto, 11 V 2000 (17289). On **Chenopodium serotinum* L. – Namyangju, 18 V 2002 (18857). On *Spinacia oleracea* L. – Namyangju, 28 X 1998 (15610); ditto, 7 IV 1999 (15680); Sinan, 26 XII 2001 (18808); ditto, 29 XII 2001 (18809).

Note: The above description is based on the specimen (SMK 17266) on *Chenopodium.* Nakata and Takimoto (1928) recorded this fungus (under *Peronospora effusa*) on *Spinacia oleracea* for the first time in Korea. Yerkes and Shaw (1959) considered that the 14 downy mildews recorded on chenopodiaceous plants belong to *P. farinosa.* Byford (1967) divided *P. farinosa* into three *formae speciales* based on cross-inoculation experiments, viz. f. sp. *betae* on *Beta* spp., *chenopodii* on *Chenopodium* spp., and *spinaciae* on *Spinacia* spp. Recently, however, Choi *et al.* (2002) suggested that *Peronospora* on *Chenopodium* and *Spinacia* should be regarded as separate species, on the basis of both morphological and molecular data.

Peronospora hylomeconis S. Ito & Y. Tokunaga

Conidiophores hyaline to subhyaline, 160-640 µm long, trunk straight, 6-9 µm wide, base not or somewhat swollen; upper part dichotomously branched

5-6 times, occasionally subdichotomous or trichotomous. Conidia pale olivaceous to olivaceous, broadly ellipsoidal, 17.5-29 × 16-21 µm (l/w = 1.1-1.4), not protruding or having a scar of attachment at the base, producing germ tubes. Oospores spherical, brown to dark brown, 25-38 µm diam.

On **Hylomecon vernale* Max. (= *Chelidonium japonicum* Thunb.) – Chunchon, 5 V 1998 (14494); ditto, 10 V 2002 (18843); Pochon, 3 VI 1999 (15940).

Note: This is the first record of this species from Korea. For a detailed discussion, see the note under *Peronospora corydalis*.

***Peronospora lamii* A. Braun**

Conidiophores subhyaline, 300-550 µm long, trunk straight, 3-12 µm wide, base mostly swollen; upper part dichotomously branched 5-7(-8) times. Conidia olivaceous to pale brownish, ovoidal to broadly ellipsoidal, 17.5-24 × 16-21.5 µm (l/w = 1.05-1.3), not protruding or having a scar of attachment at the base. Oospores not seen.

On **Lamium amplexicaule* L. – Gimhae, 22 XI 2002 (19412); Namyangju, 28 V 1999 (15887); ditto, 18 V 2002 (18862).

Note: This is the first record of this species from Korea. It is cosmopolitan in distribution and has been recorded by many authors. Constantinescu in Constantinescu and Fatehi (2002) segregated from *Peronospora* Corda (1837) two other genera, *Hyaloperonospora* and *Perofascia. Peronospora* sensu Constantinescu (ibid.) is characterized by hyphal, often branched haustoria, coloured conidia, and conidiophores of monopodially (but appearing dichotomous) branching. The specimens of *Peronospora lamii* collected by us had globose to lobate haustorium, which is characteristic for *Hyaloperonospora* Constant. This type of haustoria in *P. lamii* was previously mentioned by Fraymouth (1956). Consequently, *P. lamii* seems to be an intermediate fungus having characters of both *Peronospora* and *Hyaloperonospora*. Interestingly, Riethmüller *et al.* (2002) showed that *P. lamii* from *Lamium purpureum* is not so closely related to other *Peronospora* species, in 28S rDNA sequence analysis.

***Peronospora manshurica* (Naum.) H. Sydow**

Conidiophores hyaline, 280-660 µm long, trunk straight, (3.5-)4-9 µm wide, base not or somewhat swollen; upper part dichotomously or subdichotomously branched 6-7(-8) times; ultimate branchlets straight to substraight, 4-10 µm long, 1.5-2.5 µm wide at the base and becoming narrower upwards, apex pointed. Conidia olivaceous to grayish olivaceous, subglobose to broadly ellipsoidal, 19-26 × 17-21 µm (l/w = 1.1-1.3), not protruding at the base. Oospores spherical, pale brown to golden brown, 22-30 µm diam.

On *Glycine max* (L.) Merr. – Dongduchon, 6 IX 2002 (18960); Kangnung, 19 VIII 1989 (10188); ditto, 22 IX 1989 (10216); ditto, 10 IX 1996 (13657); Paju, 21 VIII 2001 (18249); Pyongchang, 17 IX 1996 (13675). On **Glycine soja* (L.) Sieb. & Zucc. – Chunchon, 7 VI 1998 (14628); ditto, 24 VIII 1999 (16455); ditto, 29 IX 2000 (17669); Hongchon, 21 VIII 1998 (14868); Kangnung, 9 VIII 1989 (10180); ditto, 24 IX 1991 (11115); ditto, 4 VII 1993 (12454); ditto, 20 VII 1993 (12464); ditto, 30 VIII 1994 (12959); ditto, 19 IX 1996 (13680); Kosung, 28 VIII 2002 (18939); Namyangju, 2 IX 1999 (16566); ditto, 18 V 2002 (18855); Pyongchang, 25 VIII 1997 (14019); Samchok, 2 X 2000 (17719).

Note: The first record of this species in Korea was made by Nakata and Takimoto (1928). Interestingly, the trunk of conidiophores in our collections was consistently broadening upwards, from 3.5-7.5 µm wide at the base part, to 6-9 µm wide at the upper part.

***Peronospora plantaginis* Underwood**

Conidiophores hyaline to subhyaline, 250-700(-1200) µm long, trunk straight, 6-10 µm wide, base not or somewhat swollen; upper part monopodially branched 5-6(-7) times, but appearing subdichotomous; ultimate branchlets flexuous to curved, 4-25 µm long, ca. 3 µm wide at the base and becoming narrower upwards, apex subacute. Conidia olivaceous to pale brown, broadly ellipsoidal to ellipsoidal, 32.5-40 × 17.5-22.5 µm (l/w = 1.75-1.85), protruding at the base, sometimes appearing pedicel-like, producing germ tubes laterally. Oospores not seen.

On **Plantago asiatica* L. – Dongduchon, 21 VI 1999 (16051); Pochon, 4 VII 2002 (18925); Yangpyong, 16 X 2002 (19267).

Note: This is the first record of this species from Korea.

***Peronospora rubiae* Gäum.**

Conidiophores hyaline to subhyaline, 180-680 µm long, trunk straight, 7.5-10 µm wide, base not or somewhat swollen; upper part dichotomously or subdichotomously branched 4-6(-7) times. Conidia pale olivaceous to olivaceous, obovoidal to broadly ellipsoidal, 17.5-30 × 14-23 µm (l/w = 1.1-1.5(-1.6)), becoming narrower toward the base, having pedicel-like protuberance at the base, occasionally guttulate, producing germ tubes laterally. Oospores not seen.

On **Rubia akane* Nakai – Dongduchon, 2 VI 2000 (17373); Hongchon, 29 IX 2000 (17705); ditto, 17 IX 2001 (18463); ditto, 11 X 2002 (19240); Wonju, 18 X 2002 (19279).

Note: This is the first record of this species from Korea. A few oil droplets were noticed in some conidia, but this character seems not to be consistent.

Peronospora sparsa **Berk.**

Conidiophores hyaline, 400-650 μm long, trunk substraight, 10-15 μm wide, base not or somewhat swollen; upper part dichotomously or subdichotomously branched 6-7 times. Conidia olivaceous to pale brown, broadly ellipsoidal, 20-25 × 15-22 μm (l/w = 1.05-1.3), shortly pedicellate, producing germ tubes at the randomly located sites. Oospores not seen.

On *Rosa hybrida* Hort. – Gimhae, 22 XI 2002 (19410). On **Sanguisorba officinalis* L. – Cheongju, 13 X 1999 (17066); ditto, 24 IX 2000 (17638); Chunchon, 11 X 2002 (19228); Jeongson, 16 X 2000 (17872); Pochon, 21 X 1999 (17131); Pyongchang, 3 X 2000 (17769); ditto, 7 IX 2001 (18380); Samchok, 5 VI 1994 (12846).

Note: Lee (1979) recorded this species without description for the first time in Korea. Later Lee *et al.* (1989) provided short description for the fungus based on their collection of cultivated rose. The downy mildew of *Sanguisorba* was identified as *Peronospora sanguisorbae* Gäum. by Kochman and Majewski (1970) and Vanev *et al.* (1993). Constantinescu (1996) suggested the inclusion of all *Peronospora* species parasitic on various genera of Rosaceae, excepting *Potentilla* spp. in a single species, *P. sparsa*. However, microscopic examination of the Korean collections from *S. officinalis* showed that this fungus has morphological characters slightly different from typical '*P. sparsa*'. Riethmüller *et al.* (2002) also showed that isolates from *Rosa* and *Sanguisorba* differ slightly in the 28S rDNA sequence. Nevertheless, until additional morphological and molecular studies of downy mildews on Rosaceae are made, we regard the downy mildew of *Sanguisorba* as *P. sparsa*.

Peronospora trigonotidis **S. Ito & Y. Tokunaga**

Conidiophores subhyaline to pale olivaceous, 220-700 μm long, trunk straight, 7.5-12.5 μm wide, base not or somewhat swollen; upper part dichotomously branched 5-6(-7) times. Conidia olivaceous brown with a grayish tint, broadly ellipsoidal to subglobose, 19-28 × 17-24 μm (l/w = 1.1-1.4), not protruding or having a scar of attachment at the base, producing germ tubes at randomly located sites. Oospores not seen.

On **Trigonotis peduncularis* Benth. – Suwon, 28 IV 1999 (15707); Cheongju, 29 IV 2000 (17258); Chunchon, 4 V 2000 (17265); ditto, 1 V 2002 (18822); ditto, 11 X 2002 (19203); Pochon, 3 X 2002 (19135); ditto, 23 X 2002 (19304); Pyongchang, 12 V 2000 (17305); Wando, 12 XI 2002 (18097); ditto, 8 XI 2002 (19376); Wonju, 18 X 2002 (19287); Yangpyong, 16 X 2002 (19266).

Note: This species was previously recorded from Japan (Ito and Tokunaga, 1935) and China (Pai, 1957), but not from Korea. We have examined the germination pattern in some hundreds of fresh conidia. The germ tubes emerged from the side, subapical or apical part of the conidia. The germ tube reached up to 960 µm before growth ceased, but no branching occurred.

Plasmopara halstedii **(Farlow) Berl. & de Toni**

Sporangiophores subhyaline, 180-600 µm long, trunk straight, 7.5-10 µm wide, base not or somewhat swollen; branches arising at near right angle to the main axis, monopodial, of 5 to 7(-8) orders. Sporangia pale olivaceous to subhyaline, oblong to somewhat ovoidal, variable in size and shape, 18-48 × 13-26 µm (l/w = 1.1-1.9), greatest width submedian, not protruding or having a scar of attachment at the base, releasing zoospores through the apical pore. Oospores not seen.

On *Helianthus annuus* L. – Chunchon, 13 V 1999 (15798); ditto, 28 VI 2002 (18911); Suwon, 9 VI 1988 (10106).

Note: This well-known sunflower downy mildew fungus was recorded by Shin (1991) for the first time in Korea.

Plasmopara obducens **(Schröter) Schröter**

Sporangiophores subhyaline, 340-700 µm long, trunk straight, 4-9 µm wide, base not or somewhat swollen; branches arising at near right angle to the main axis, monopodial, of 3 to 5(-6) orders; callose plugs present. Sporangia subhyaline, broadly oblong, sometimes nearly globose, 14-20 × 12-16 µm (l/w = 1.0-1.3), operculate at the apex, very shortly pedicellate or not protruding at the base. Oospores not seen.

On **Impatiens textori* Miq. – Chunchon, 29 V 1999 (15905); ditto, 11 X 2002 (19204).

Note: This is the first record of this species from Korea.

Plasmopara orientalis **Constant.**

Sporangiophores subhyaline, 400-700(-970) µm long, trunk straight, 10-12 µm wide, base not or somewhat swollen; branches arising at right angle to the main axis, monopodial, of 3 to 5(-7) orders; callose plugs frequently present. Sporangia pale olivaceous, ovoidal, 16-20 × 12-17 µm (l/w = 1.1-1.3), very shortly pedicellate, releasing zoospores through the apical pore. Oospores not seen.

On **Schizopepon bryoniaefolius* Max. – Pyongchang, 6 VII 1999 (16233); ditto, 6 VI 2002 (18875); ditto, 27 IX 2002 (19083).

Note: This species was very recently described, based on specimens collected in Far East Russia, China and Japan (Constantinescu, 2002). The present record extends its distribution area to Korea.

Plasmopara plectranthi **L. Ling & M.C. Tai**

Sporangiophores subhyaline, 260-620 µm long, trunk straight, 4-7.5 µm wide, base not or somewhat swollen; branches arising at near right angle to the main axis, monopodial, of 3 to 5 orders, higher order branches somewhat di- or trichotomous, giving compact appearance; callose plugs present. Sporangia subhyaline, obovate to ovoidal, 17.5-30 × 13.5-19 µm (l/w = 1.2-1.7), operculate at the apex, not or slightly protruding at the base. Oospores not seen.

On *_Plectranthus inflexus_ (Thunb.) Vahl ex Benth [= _Isodon inflexus_ (Thunb.) Kudo] – Kangnung, 5 X 1991 (11230); ditto, 13 X 1991 (11306); ditto, 15 X 1992 (12192); ditto, 28 X 1992 (12326); ditto, 23 X 1993 (12739); ditto, 18 X 1994 (13168); ditto, 18 X 1996 (13727); ditto, 24 IX 1998 (15236); ditto, 17 X 2000 (17917); Samchok, 2 X 2000 (17720). On *_Plectranthus japonicus_ (Burm.) Koidz. [= _Isodon japonicus_ (Burm.) Hara] – Kangnung, 3 X 2000 (17751).

Note: This species has hitherto been recorded only in China, and this is the first record of this species from Korea.

Plasmopara viticola **(Berk. & M.A. Curt.) Berl. & de Toni**

Sporangiophores subhyaline, 240-720 µm long, trunk straight, 6-13 µm wide, base not or somewhat swollen; branches arising at right angle to the main axis, monopodial, alternate, of 3 to 5 or up to 6 orders; ultimate branchlets straight, 2-6 µm long, 0.5-1.5 µm wide at the base and becoming narrower upwards, apex truncate; callose plugs present. Sporangia subhyaline, variable in shape and size, ovoidal to shortly ellipsoidal, 14-28 × 11-18 µm (l/w = 1.1-1.6), shortly pedicellate, releasing zoospores through the apical pore. Oospores spherical, brown to dark brown, 20-28 µm diam.

On *_Ampelopsis brevipedunculata_ var. _heterophylla_ (Thunb.) Hara – Jeju, 1 XI 2002 (19334); Kangnung, 13 IX 1989 (10209); ditto, 14 IX 1991 (11046); ditto, 6 X 1996 (13701); ditto, 5 X 2001 (18552); Pyongchang, 27 IX 2002 (19090); Samchok, 28 VIII 2002 (18950); Seoul, 4 IX 1998 (15022); Wonju, 29 VIII 2000 (17450). On *_Vitis amurensis_ Rupr. – Chunchon, 2 X 1990 (10483); ditto, 2 X 1990 (10484); ditto, 29 IX 2000 (17668); Jeju, 1 XI 2002 (19353); Kangnung, 22 IX 1994 (13048); ditto, 28 IX 1994 (13073); Paju, 21 VIII 2001 (18248); Pochon, 30 VIII 2000 (17456); Pyongchang, 25 VIII 1997 (14023); ditto, 13 IX 1999 (16653); Seoul, 30 IX 1999 (16878); ditto, 12 X 2000 (17831). On *_Vitis flexuosa_ Thunb. – Kyongju, 25 VIII 1998 (14896); Dongduchon, 9 X 2000 (17781); Pochon, 18 IX 2002 (19032). On _Vitis vinifera_ L. – Pyongchang, 27 IX 2002 (19084); Seoul, 26 VIII 1998 (14939); ditto, 28 VIII 1998 (14956).

Note: Nakata and Takimoto (1928) recorded this species from *Vitis vinifera* for the first time in Korea. The callose plugs on trunks were commonly formed below the primary-order branches, and the width of trunks below callose plugs became abruptly narrower.

***Plasmopara* sp.**

Sporangiophores subhyaline, 120-360 µm long, trunk straight, 5-7.5 µm wide, base not or somewhat swollen; branches arising at variable (but not right) angle to the main axis, monopodial, of 3 to 5 orders, sometimes appearing subdichotomous; callose plugs present. Sporangia very pale olivaceous to subhyaline, variable in shape and size, broadly oblong to subglobose, 16-34 × 15-23 µm (l/w = 1.1-1.6), not protruding or very shortly pedicellate, releasing zoospores through apical pore. Oospores not seen.

On *Geranium koreanum* Kom. – Kangnung, 13 X 1991 (11308); ditto, 15 X 1991 (11326); ditto, 27 X 1991 (11403); ditto, 14 XI 1991 (11491); ditto, 14 V 1992 (11583); ditto, 3 VI 1992 (11640); ditto, 19 V 1993 (12396); ditto, 10 V 1998 (14504). On *Geranium nepalense* subsp. *thunbergii* (Sieb. & Zucc.) Hara – Jeju, 31 X 2002 (19324); ditto, 1 XI 2002 (19358); Kangnung, 17 X 2000 (17918); Pochon, 18 IX 2002 (19026); ditto, 23 X 2002 (19303); Seoul, 2 X 2002 (19127); Wando, 8 XI 2002 (19380); Wonju, 18 X 2002 (19276).

Note: The phenetic characters of this fungus diverge from both the Eurasiatic *Plasmopara pusilla* (de Bary) Schröter, and the North American *Plasmopara geranii* (Peck) Berl. & de Toni, parasitic on other species of *Geranium*. Morphological and molecular studies in progress show that it is most probably a new taxon.

***Pseudoperonospora celtidis* (Waite) G.W. Wilson**

Sporangiophores subhyaline, 170-280 µm long, trunk straight, 5-8 µm wide, sometimes becoming narrower downwards, base somewhat swollen; branches monopodial, alternate, of 3 or 4 orders, may appearing subdichotomous; ultimate branchlets straight, 5-10 µm long, 1.5-2 µm wide at the base, apex subtruncate; callose plugs frequently present, 2 to 4 per sporangiophore. Sporangia pale brown, ellipsoidal, variable in size and l/w ratio, 27-44 × 16-23 µm (l/w = 1.5-2.2), shortly pedicellate, having thin-walled pore at the apex. Oospores not seen.

On *Celtis sinensis* Pers. – Dongduchon, 9 X 2000 (17780).

Note: This is the first record of this species from Korea. The callose plugs in the sporangiophores of this species were neither described nor illustrated by earlier authors (Waterhouse and Brothers, 1981; Yu *et al.*, 1998). In our collection 2-4 callose plugs were present in every sporangiophore, located along the trunks and branches.

***Pseudoperonospora cubensis* (Berk. & M.A. Curt.) Rostov.**

Sporangiophores hyaline to subhyaline, 140-480 μm long, trunk straight, 5-8 μm wide, base somewhat swollen; branches monopodial, of 3 to 4 orders, sometimes appearing dichotomous; ultimate branchlets straight, apex subtruncate. Sporangia olivaceous brown, ellipsoidal, 22-38 × 15-22 μm (l/w = 1.4-2.0), shortly pedicellate or somewhat protruding, having thin-walled apical pore. Oospores not seen.

On *Cucumis melo* var. *makuwa* Makino – Chunchon, 27 IX 1997 (14255); Kangnung, 26 VII 1991 (10922); ditto, 12 X 1991 (11284); Pyongchang, 18 VIII 1993 (12546). On *Cucumis melo* var. *reticulatus* Naud. – Gimhae, 19 IX 1998 (15170). On *Cucumis sativus* L. – Kangnung, 16 IX 1990 (10411); ditto, 7 XI 1990 (10679); ditto, 12 X 1992 (12174); ditto, 16 X 1992 (12196); ditto, 20 IX 1993 (12633); ditto, 17 X 2000 (17916); Namyangju, 26 VI 1999 (16138); ditto, 11 VII 2001 (18229); Samchok, 29 VIII 2002 (18951); Seongnam, 30 V 1998 (14584); Suwon, 5 IX 2000 (17507); ditto, 19 VI 2002 (18903). On *Cucurbita moschata* Duchesne – Bonghwa, 22 X 1994 (13188); Chunchon, 27 IX 1997 (14257); ditto, 11 X 2002 (19205); Kangnung, 6 X 1992 (12076); ditto, 12 X 1992 (12173); ditto, 28 X 1992 (12310); ditto, 25 IX 1994 (13067); ditto, 31 X 1994 (13288); ditto, 2 XI 1994 (13331); ditto, 10 IX 1996 (13656); Kosung, 21 X 2000 (17935); Kyongju, 25 VIII 1998 (14897); Pyongchang, 8 IX 1996 (13644); ditto, 3 X 2000 (17766); Yangku, 2 X 1994 (13130).

Note: The first collection of this species from Korea was recorded by Nakata and Takimoto (1928) from *Cucumis sativus*, followed by Park (1958) from *Cucurbita moschata* and by Cho *et al.* (1997) from *Cucumis melo*. Microscopic examination showed that the branches of this species are definitely monopodial, alternate, of 3 to 4 orders.

***Pseudoperonospora humuli* (Mayabe & Tokahashi) G.W. Wilson**

Sporangiophores subhyaline, 120-460 μm long, trunk straight, 5-10 μm wide, base not or somewhat swollen; branches monopodial, of 3 to 4 orders, may appearing dichotomous; ultimate branchlets straight to substraight, (4-)10-13(-15) μm long, 2-3.5 μm wide at the base, apex obtuse. Sporangia pale olivaceous to olivaceous, ellipsoidal, 22-33 × 15-19 μm (l/w = 1.4-1.7), greatest width submedian (mostly 2/3 position from the base), not or very shortly protruding at the base, releasing zoospores through the apical pore. Oospores not seen.

On *Humulus japonicus* Sieb. & Zucc. – Kangnung, 24 IX 1990 (10446); ditto, 2 V 1991 (10719); ditto, 3 V 1991 (10722); ditto, 15 VI 1991 (10758); ditto, 27 V 1992 (11608); ditto, 20 X 1992 (12219); Namyangju, 18 V 2002 (18856); Samchok, 11 XI 1994 (13380). On *Humulus lupulus* L. – Suwon, 14 VI 1992 (11675).

Note: Park (1958, 1967) recorded this species from *Humulus japonicus* and *H. lupulus* in Korea. The branching pattern of sporangiophores in this species has been described as dichotomous (Kochman and Majewski, 1970; Waterhouse and Brothers, 1981; Yu *et al.*, 1998). Our observations on the specimens from Korea showed that the branching is definitely monopodial, of 3 to 4 orders, and the branches are alternate.

ADDITIONAL LIST

The following downy mildews and their host plants were recorded previously in Korea (The Korean Society of Plant Pathology, 1998). Very little information on the fungi was given, and the specimens were not preserved. Consequently, their occurrence in Korea is somewhat doubtful.

Peronospora arborescens (Berk.) de Bary on *Papaver somniferum* L. (Park, 1961).

Peronospora schachtii Fuckel on *Beta vulgaris* var. *rapacea* C. Koch (Nakata, 1914).

Peronospora trifoliorum de Bary on *Medicago sativa* L. (Fujiguro, 1925, ex The Korean Society of Plant Pathology, 1998).

Plasmopara miyakeana Ito & Yoku on *Urtica thunbergiana* Sieb. (Lee *et al.*, 1982).

Pseudoperonospora cannabina (Otth) Curzi on *Cannabis sativa* L. (Lim *et al.*, 1962, ex The Korean Society of Plant Pathology, 1998).

Sclerophthora macrospora (Sacc.) Thirum., C. G. Shaw & Naras. on *Oryza sativa* L. (Chung *et al.*, 1974) and on *Zea mays* L. (Chung *et al.*, 1992).

Sclerospora graminicola (Sacc.) Schröter on *Setaria italica* Beauv. (Takimoto, 1916).

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FIRST RECORD OF ERYSIPHE WEIGELAE FROM KOREA AND ITS ANAMORPH

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ABSTRACT: *Erysiphe weigelae*, a powdery mildew fungus on *Weigela* spp., has hitherto been recorded from China and Japan. The anamorphic characters of this species were poorly known. The conidial state of this species is described and illustrated based on Korean collections. The presence of secondary hyphae found in *E. weigelae* represents the first record for a powdery mildew of the tribe Erysipheae.

Keywords: *Weigela*, powdery mildew, Erysiphaceae, primary conidia, secondary hyphae

Based on extensive collections and identifications of powdery mildew fungi from Korea by the senior author, a monograph entitled "Erysiphaceae of Korea" was published (Shin, 2000). Many of his collections were not treated in his compilation, mainly because these specimens contained only anamorphic states or immature ascomata. Since the anamorphs of many powdery mildew species are insufficiently known, the possibilities to identify such fungi based on anamorphic characteristics are rather limited (Boesewinkel, 1980; Braun *et al.*, 2002).

Six anamorphic powdery mildew specimens on *Weigela* spp. were collected in Korea between 1998 and 2001. They have been deposited in the herbarium SMK (Systematic Mycology of Korea, Korea University, Korea) with tentative identifications as '*Oidium* sp. (possibly *Erysiphe weigelae* based on their conidial dimension)'. In October 2002, a powdery mildew on *Weigela* *subsessilis*, containing the anamorph as well as teleomorph, was collected, so that a reliable microscopic examination and identification of the powdery mildews on *Weigela* spp. in Korea was possible.

Four species of powdery mildew fungi have hitherto been recorded on *Weigela* spp. of Caprifoliaceae, viz., *Erysiphe diervillae* Miyabe ex U. Braun from Japan (Braun, 1983; Nomura, 1997), *Erysiphe weigelae* Z.X. Chen & S.B. Luo from China (Chen *et al.*, 1984) and Japan (Nomura, l.c.), *Microsphaera weigelae* Y. Nomura & Tanda [≡ *Erysiphe weigelae* (Y. Nomura & Tanda) U. Braun & S. Takam.] from Japan (Nomura, l.c.), and *Uncinula lata* Y. Nomura & Tanda [≡ *Erysiphe lata* (Y. Nomura & Tanda) U. Braun & S. Takam.] from Japan (Nomura, l.c.).

The conidial state of *E. diervillae* was described and illustrated by Nomura (l.c.). The other three species of powdery mildews were described on the basis of their teleomorphs without adequate information on their corresponding anamorphic states. Preliminary examinations of conidia and conidiophores from six Korean specimens collected between 1998 and 2001 revealed obvious differences to the data given in Nomura (l.c.): conidia 22-38×12.5-16 μm (34-40×18-22 μm in Nomura, l.c.) and conidiophores 45-110×7-10 μm (95-125×10-14 μm in Nomura, l.c.).

The morphological characteristics of the ascomata from the Korean material were very close to those of *E. weigelae* (Table 1). According to the original description by Chen *et al.* (1984), *E. weigelae* is characterized by having long, aseptate, non-branched, undulate appendages arising from the lower half of the ascomata. In the Korean material, the apical parts of the long appendages were circinate, suggesting that this species belongs to the genus *Uncinula* Lév. (Fig. 1A). Since Takamatsu *et al.* (1999) and Braun and Takamatsu (2000) reduced the genus *Uncinula* to synonymy with *Erysiphe*, it is not necessary to transfer this species to *Uncinula*. The present species, however, should be included in *Erysiphe* sect. *Uncinula* (Lév.) U. Braun & S. Takam.

The anamorphic characteristics of this species were poorly known. Braun (1987) only described 'conidia formed singly, subcylindrical, ca. 30-36×16-18 μm', and Nomura (1997) 'conidiophores arising from the upper part of mother cells, straight, producing conidia singly; conidia oval to ellipsoidal, 28-36×17-20 μm'. Other characters of taxonomic value have not been described. The microscopic examination of seven Korean samples revealed that they are very similar to each other and also in good agreement with two previous records. The connection of the anamorph and teleomorph was confirmed by examining conidial state and ascomata from the same colony. The following description of this species is based on the specimen (SMK 19238), which contains both anamorph and teleomorph on the same colony.

Table 1. Comparative morphological characteristics of the teleomorphic state of *Erysiphe weigelae.*

Character	Chen *et al.* (1984)	Nomura (1997)	Present study
Host	*Weigela japonica* var. *sinica*	*Weigela hortensis*	*Weigela subsessilis*
Ascomata			
Diameter (µm)	107-124	90-130	90-125
Shape	depressed globose	depressed globose	depressed globose
Appendages			
No. per ascoma	5-17	12-24	6-18
Length (µm)	124-401	50-400	140-520
Septation	aseptate*	aseptate	aseptate
Asci			
No. per ascoma	5-11	6-12	6-12(-15)
Size (µm)	59-62.5×37.5-40	56-78×28-38	60-75×38-45
Shape	ellipsoidal	ellipsoidal	ellipsoidal
Base	short stalked to subsessile	short stalked to subsessile	short stalked to subsessile
Ascospores			
No. per ascus	8	8	8
Size (µm)	15.0-18.8×8.8-11.3	16-20×10-12	16-22.5×10-12.5
Shape	ovoid to oblong-ellipsoidal	ellipsoidal to oval	ellipsoidal to oval
Color	light yellow	- (not described)	yellowish

* mostly aseptate, occasionally having indistinct septa

Conidial state of *Erysiphe weigelae* Z.X. Chen & S.B. Luo (Chen *et al.*, 1984); non *E. weigelae* (Y. Nomura & S. Tanda) U. Braun & Takam. (Braun & Takamatsu, 2000), later homonym. Figs 1, 2

Mycelium amphigenous, cauligenous, persistent, forming circular white patches on the upper leaf surface, evanescent on the lower surface of mature leaves, sometimes covering the whole herbaceous stems and young leaves at the apex of shoot; old colonies becoming pale ochre to pale grayish, dense, somewhat glassy under a dissecting microscope due to the aerial secondary hyphae. **Hyphae** hyaline, substraight to geniculate, 36-80(-106)×4-6.5 µm, usually less than 60 µm long when having appressoria and/or conidiophores, mostly branching at right angle, usually with a septum near the branching point. **Appressoria** moderately lobed to multilobed, mostly single. **Secondary hyphae** formed at the later stage of anamorphic state, arising from

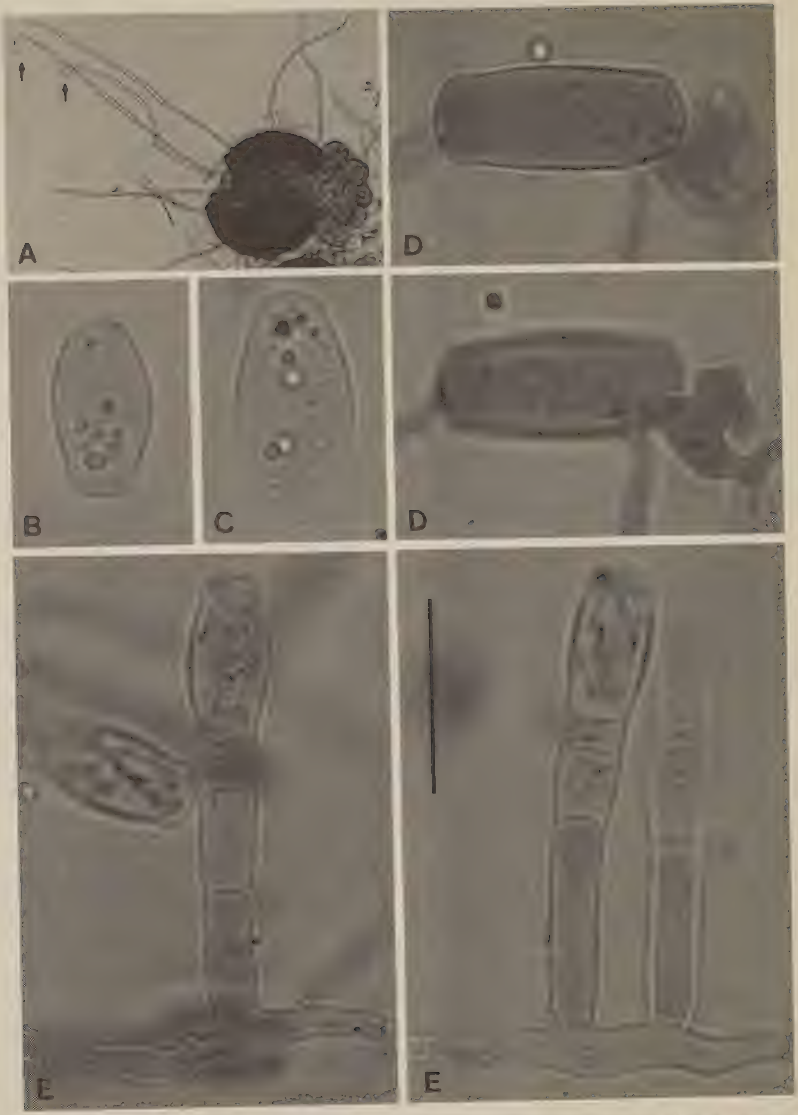

Fig. 1. *Erysiphe weigelae.* (A) Ascomata with appendages. Uncinate apex of long appendages (arrows). (B) Primary conidium, (C) Conidium, (D) Germinating conidium. Conidium producing germ tubes at three subterminal positions, (E) Conidiophores formed from a mother cell. Bar = 30 µm, but 160 µm for A.

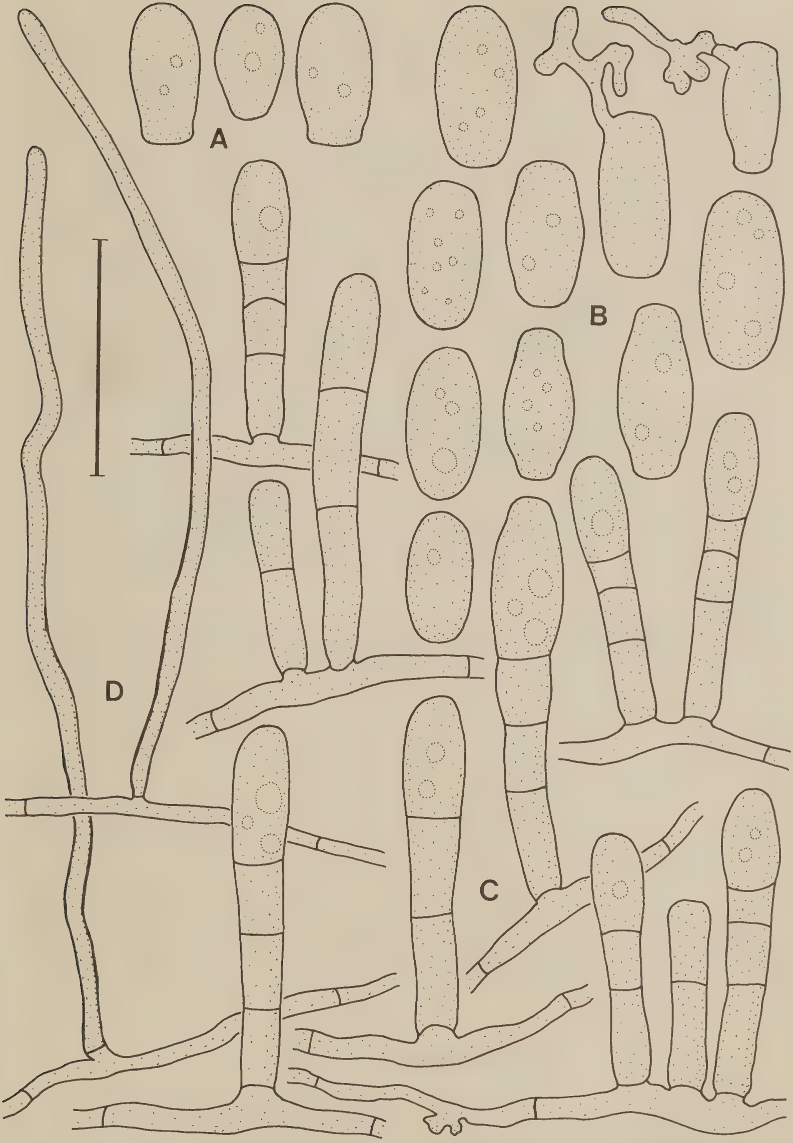

Fig. 2. Anamorphic characteristics of *Erysiphe weigelae*. (A) Primary conidia, (B) Conidia, (C) Conidiophores, (D) Secondary hyphae. Bar = 50 µm.

primary hyphae, separated from the primary hyphae by a basal septum at the branching point, occasionally found at the end of generative hyphae (the apical cell of generative hyphae turning into a non-septate secondary hypha), substraight to curved or even somewhat undulate, smooth, walls thicker than generative hyphae, mostly aseptate, but occasionally having a few inconspicuous septa, individually hyaline, but pale ochre in mass, 160-320 μm or even longer, 3-5 μm wide, but usually becoming wider at the upper part. **Conidiophores** single or up to three on a hyphal cell, arising from the upper part of mother cells, position mostly central, 45-110×7-10 μm, becoming broader upwards, foot-cells straight, slightly constricted at the branching point, producing conidia singly, followed by (1-)2-3 straight shorter cells, with a basal septum at the branching point of the mycelium. **Primary conidia** somewhat spathulate, usually smaller than secondary conidia; **secondary conidia** ellipsoidal to cylindrical oval, (18-)22-38×12.5-16(-18) μm (length/width = 1.6-2.6), without conspicuous fibrosin bodies, occasionally guttulate, producing subterminal germ tubes.

Collections examined: On *Weigela florida* (Bunge) A. DC., SMK 14682 (28 VI 1998, Dongduchon), 15220 (24 IX 1998, Kangnung), 16259 (7 VII 1999, Kangnung), 16737 (19 IX 1999, Wonju); on *Weigela subsessilis* L.H. Bailey, SMK 17213 (7 XI 1999, Seoul), 18477 (22 IX 2001, Namhae), 19238 (11 X 2002, Hongchon).

Note: The anamorph of *E. weigelae* (*Pseudoidium*, conidia formed singly) is unique within species of *Erysiphe* emend. Braun & Takamatsu (2000) by having well-developed secondary mycelium, so far only known from species of the genera *Blumeria*, *Cystotheca*, *Podosphaera*, and *Sphaerotheca*, which are characterized by having *Euoidium* anamorphs with conidia formed in chains (Boesewinkel, 1980; Shin, 2000; Braun *et al.*, 2002). This is the first record of the presence of secondary mycelium in a species of the Erysipheae.

It is also noteworthy that the primary conidia of *E. weigelae* differ from the secondary ones by being spathulate, rounded at the apex and subtruncate at the base. In fact, in most or possibly all powdery mildew fungi with *Oidium* anamorphs produce more or less spathulate primary conidia (unpublished data, Shin). The primary conidia can be easily observed in very young colonies of powdery mildews.

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THE HYPOCREACEAE OF CHINA VI. A NEW SPECIES OF THE GENUS HYPOCREA

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ABSTRACT

A new species of the genus *Hypocrea* growing on rotten wood of *Castanopsis* sp. in a tropical rain forest Yunnan, China is identified, described and illustrated, for which a new scientific Latin name *Hypocrea tropicosinensis* is proposed. Its single ascospore (partspore) culture yielded conidiophores with smooth and green conidia belonging to the form-genus *Gliocladium.*

KEY WORDS: *Hypocrea tropicosinensis*, *Gliocladium deliquescens*-type, *Gelatinosa*-group

During the last ten years, some specimens of the family Hypocreaceae were collected and identified in China. Among them some interesting and noteworthy, new species and new records to China as well as their anamorph stages were described and reported (Liu & Doi, 1995; Liu *et al.*, 1999, 2000, 2002; Wang & Liu, 2002). An interesting specimen, which was collected from the tropical area of Yunnan, southwestern China, produces an imperfect state of the *Gliocladium deliquescens*-type in culture and also possesses some distinctive and diagnostic characteristics in its perfect state. The fungus is considered to be a new species, for which a new Latin name, *Hypocrea tropicosinensis* P. G. Liu is proposed, and described below. The holotype is deposited in the Cryptogamic Herbarium, Kunming Institute of Botany, Chinese Academy of Sciences (HKAS).

***Hypocrea tropicosinensis* P. G. Liu, sp. nov.** **(Fig. 1)**

Status perfectus. *Stromata dispersa, disciforma vel pulvinata hemisphaericae, griseo-brunnea vel nigro-brunnea in sicco. 0.5–1.2 mm in diam., 0.2–0.4 mm crassa, raro plus minusve concavus ad centro in vivo. Cortex stromae ex cellulis 4.5–9.0 µm diam., crasse tunicatis compositus. Medulla pseudoparenchymatica ad basim cellulis ad 50 µm long et 5.2–10.5 µm crassis composita. Perithecia numerosa, globosa vel subglobosa, 160–210 µm in diametro verticali, 130–180 µm in diametro transversi, saepe dense aggregata et lateralibus applanata. Paraphyses non ades. Asci numerosi, cylindracei 120–180 × 5.0 µm, octospori. Ascosporae uniseriateae, normaliter divisiae interiore ascorum. Partsporae virid, verrucosae, partsporis distalibus subglobosis vel ovoidesis, 4.0–5.4 × 3.9–4.6 µm; partsporis proximalibus obovoidesis vel subcylindricis, 5.0–7.5 × 3.8–4.5 µm.*

Status imperfectus. *Auctis tardis, hyphis aeriis vix formantibus praeter conidiophora. Conidiophora in cultura pura prodita, ramosa, plerumque aggregata, specius Gliocladium-deliquecens typicis satis simila; Conidia viridia vel atroviridia in massis, laevigata, saepe ad basim truncata, versiformia, vulgo subcylindrica, ellipsoidea vel obovato-ellipsoidea, 3.1–9.3 × 2.3–4.0 µm. Chlamydosporae non visae. Agaria reversa castanea brunnea colorata.*

Hab. in barkis emortuis Castanopsis sp. *in silvis tropicis forestis, Cuipingfengis Tropicalis Rainiis Forestiis Parkis, Mengla County, Yunnan, Southwestern China, 800 m altitutis, 1st Oct. 1993, Y. Doi et Liu, D'93-40 (**Holotypus** HKAS 26198, Isotypus TNS-D-8680).*

Perfect state. Perithecial stromata 0.5–1.2 mm in diam., 0.2–0.4 mm thick, disperse, grey brown to black brown, hemispherical pulvinate or disciform, smooth, ostioles somewhat darker, margins incurved, attached to substratum by a little narrow base and a central core. Surface of stromata slightly roughed due to perithecial protuberances, rare and slightly concave at center. Tissue of the surface of stroma on which perithecial ostioles situated of *textura angularis*, close to *textura globulosa*, brownish, cells slightly thick-walled, generally rounded or irregular, 4.5–9.0 µm in diam. Inner tissue of *textura intricata*, close to *textura prismatica*, its cells transversely elongated, generally 5.2–10.5 µm in diam., hyaline. Perithecia globose or subglobose, 160–210 µm in vertical diam., 130–180 µm in transverse diam., necks of ostioles 50–60 µm long, 30–45 µm in diam. Asci numerous, cylindrical, 120–180 × 5.0 µm. Paraphyses not found. Ascospores uniseriate, bicellular, divided into two partspores when perfectly matured. Partspores green to dark green,

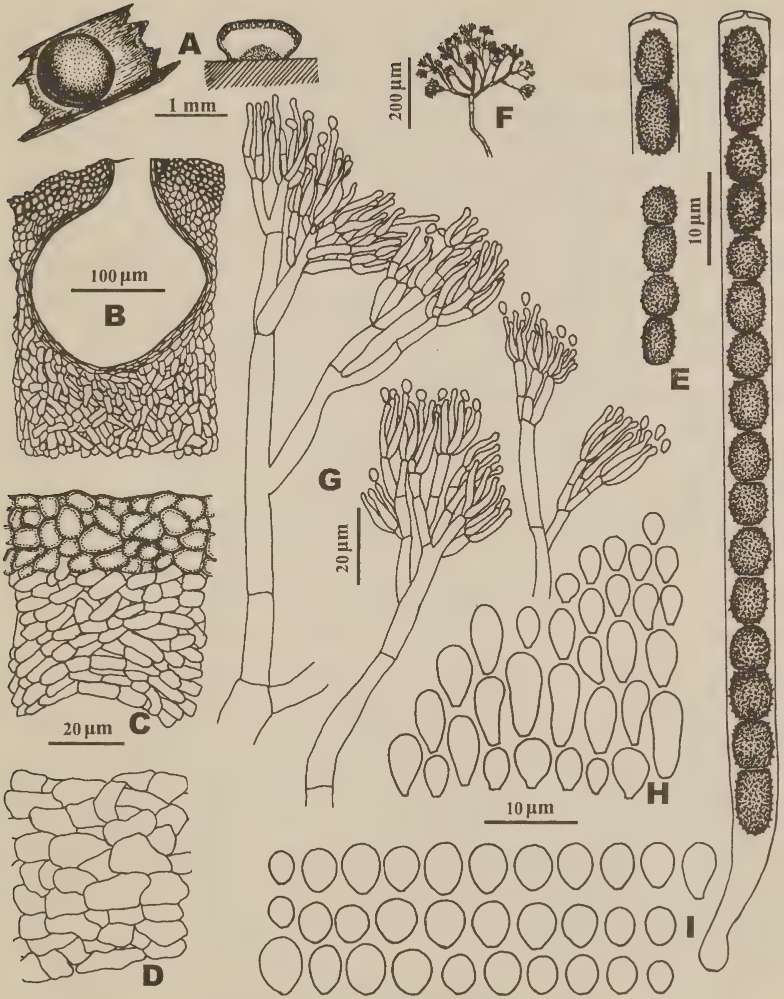
A
1 mm
B
100 µm
C
20 µm
D
E
10 µm
F
200 µm
G
20 µm
H
10 µm
I

Fig.1 ***Hypocrea tropicosinensis*** (HKAS 26198-Holotype)

A. Habit and vertical section of stroma; B. Vertical section of a perithecium; C. Vertical section of tissue of the ostiolate surface; D. Vertical section of the inner tissue; E. Asci and partspores; F–G. Conidiophores and phialides (*Gliocladium deliquescens*-type); H. Conidia in young stage; I. Conidia in aged stage.

with strongly pyramidical warts; the distal subglobose to ovoid, 4.0–5.4 × 3.9–4.6 μm, up to 5.4–6.0 μm long at the mid-points of asci; the proximal ovoid to subcylindrical, 5.0–7.5 × 3.8–4.5 μm.

Habitat. On decaying wood of *Castanopsis* sp.

Holotype. Cuipingfeng Tropical Rain Forest Park, Mengla county, Yunnan Province, 800 m altitude, 1-X-1993, Y. Doi & P. G. Liu (**Holotype!** HKAS 26198, **isotype** TNS-D-8680).

Cultures. Single partspore cultures were prepared from the collections. Partspores began germinating two days later, but germ tubes were not found, with colonies appearing until the sixth day after plating. Appearance of the colony was byssoid, floccose and white, with mycelium mostly confined to the surface substratum of the medium, with only conidiophores projecting. With age the colonies became green due to many green conidia produced and spread out over the culture medium. Mycelia in the substratum were infrequently branched, twisting and separated.

Aerial hyphae were scarce except for the conidiophores which were separated, often branched penicillately at each upper part, quite similar to typical *Gliocladium deliquescens* series-type, compactly tufted and forming restricted minute, thin, dispersed and whitish colonies, these becoming green after conidia were produced and dispersed on the medium. The main hyphae of conidiophores were up to 540 μm long, 6.7–11.9 μm in diam. Phialides were elongate, becoming ampuliform, their base scarcely narrower than their middle, and then attenuating towards their apices into a short or longer conical or subcylindrical neck 9.5–18.0 μm long, 1.5–2.9 μm in diam., crowded in the tips of the branches and forming a compact penicillia-like brush. Conidia usually very variable in shape, elongate oblong, sometimes subcylindrical, oblong-cylindrical, obovate or obovate-subglobose, often with a narrower and truncate base, smooth, green to dark green in mass, 3.9–9.3 × 2.3–4.0 μm. Chlamydospores not observed even in old cultures. Reverse side pale chestnut brown. No distinctive odor was detected from the colonies.

Notes. The *textura angularis*-type stroma surface, green partspores and conidia, together with the anamorph of *Gliocladium deliquescens*-type, indicate that this species belongs in the subgenus *Hypocrea* (Doi, 1969), section *Hypocrea*, subsection *Creopus* (Link) Yoshim. Doi, and *Gelatinosa*-group.

The morphology of the conidial apparatus of this new taxon is similar to *H. gelatinosa* (Tode : Fr.) Fr., but the latter's conidiophores bear short lateral branched clusters of phialides arranged in a manner reminiscent of the form-genera *Penicillium* or *Trichoderma* or *Gliocladium* and its ovoid and smaller conidia, only 3.7–4.7 × 2.8–3.0 µm (Webster, 1964; Doi & Doi, 1979). This new species is of typical *Gliocladium*-type. It is also somewhat similar to *H. psychrophila* E. Müll. *et al.*, but they are easily distinguishable because the latter has golden-yellow stromata, psychrophilic growth and a red-pigmented *Gliocladium*-like conidial state with whitish conidia (Müller *et al.*, 1972). At first glimpse, *H. tropicosinensis* could be taken for the Japanese species *H. luteo-virens* Yoshim. Doi, but the latter's stromata are yellow-brown in fresh material, reddish brown in dried specimens, and the distal partspores (3.2–4.1 × 2.9–3.2 µm), the proximal partspores (3.8–4.6 × 2.8–3.1 µm) and conidia (2.4–7.5 × 1.9–2.2 µm) are smaller, the conidiophores are of the *Gliocladium virens*-type, close to the *Trichoderma*-type, and the reverse side of the medium is not colored (Doi, 1972). The presence of *Gliocladium deliquescens*-type conidiophores suggests that this species is quite similar to *H. lutea* (Tode) Petch, but *H. lutea* differs in hyaline partspores and smaller green conidia (2.5–4.0 × 2.2–2.5 µm) (Petch, 1938; Doi, 1966).

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中国肉座菌科 VI. 肉座菌属一新种

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汉文摘要 报道了发现于云南热带雨林的肉座菌属（*Hypocrea*）的一个新种——中华热带肉座菌 ***Hypocrea tropicosinensis***。其单孢子分离培养产生光滑、绿色的分生孢子，无性阶段的分生孢子梗属于粘孢霉菌型（*Gliocladium deliquescens*-type）的形态（分生孢子）阶段。附有性阶段和无性阶段详细描述和宏、微观图示。

A version of this paper in printer-friendly PDF format is available at <http://www.kib.ac.cn/fungi>.

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A STUDY OF THE TYPE AND ADDITIONAL MATERIALS OF BOLETUS THIBETANUS[*]

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Abstract: Based on study of the type and additional materials, *Boletus thibetanus* is described and illustrated in detail. Data showed this species is a member of the genus *Aureoboletus*. Misinterpretation of the concept of this species in the literature was discussed.

Key words: *Aureoboletus*, new description

Boletus thibetanus Pat. was described by Patouillard (1895) from southwestern China. Although this species is very characteristic, it has been poorly documented in the literature (see Chiu, 1948, 1957; Zang *et al.*, 1993; Ying & Zang, 1994; Zang, 1996). Thus, misinterpretation of the concept of this species is unavoidable (see remarks). Furthermore, the systematic position of this species is still uncertain. In the past, *Boletus thibetanus* was transferred into the genera *Suillus* P. Micheli ex Adans. (Tai, 1979), *Aureoboletus* Pouzar (Hongo & Nagasawa, 1980), and then *Pulveroboletus* Murrill (Singer, 1986).

The first two authors made some field observations of this species in the last few years, and restudied the type deposited in Farlow Herbarium (FH), Harvard University, and additional materials in the Herbarium of Cryptogams of Kunming Institute of Botany (HKAS) and Mycological Herbarium of the Institute of Microbiology, Academia Sinica (HMAS).

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The last author made a phylogenetic analysis of this species with some members of boletoid fungi based on large-subunit ribosomal DNA sequences (data unpublished). Our morphological and molecular data showed this species is a member of *Aureoboletus* Pouzar (Li & Song, 2002). In this article, a detailed description and illustrations for this species are provided. Figures 1–4, 6–7 were illustrated using fresh material. Methodology and notation follow those of Yang (2000), and Yang *et al.* (2001). Color names with first letters capitalized, e.g. Olive-Yellow, are from Ridgway (1912); color codes of the form "4D5–6" are from Kornerup & Wanscher (1981).

Aureoboletus thibetanus (Pat.) Hongo & Nagas., Rep. Tottori Mycol. Inst. 18: 133, 1980; Zang, Yuan & Gong, Acta Mycol. Sinica 12: 275, fig. 1/1-2, 1993; Ying & Zang, Economic Macro- fungi Southwestern China: 226, 1994; Zang, Fungi Hengduan Mountains: 256, 1996.

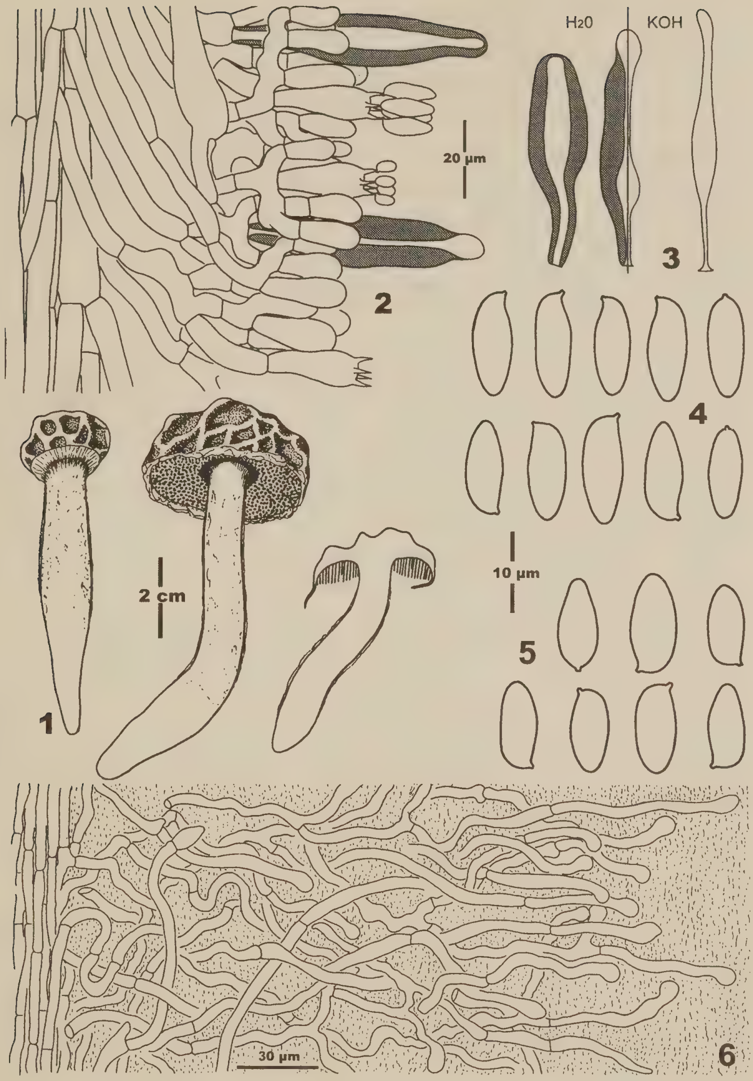
Boletus thibetanus Pat., Bull. Soc. Mycol. France 11: 196, Pl. XIII, fig. 2, 1895; Chiu, Mycologia 40: 204, 1948; Chiu, Atlas Yunnan Boletes: 26, 1957.

Suillus thibetanus (Pat.) F. L. Tai, Syll. Fung. Sinic.: 736, 1979.

Pulveroboletus thibetanus (Pat.) Singer, Agaricales Modern Taxon. (4th ed.): 774, 1986.

Figs. 1–7

Fruitbody (Fig. 1) usually small. Pileus 1.5–5 cm in diam., convex to applanate, chestnut-brown, rusty brown to pale brown, sometimes with dull reddish tinge, distinctly reticulate, sometimes coarsely rugose, rarely nearly flat, strongly viscid when wet; margin appendiculate with yellowish then hyaline to subhyaline, strongly gelatinized veil remnants. Context up to 8 mm thick at center, whitish yellow to yellow, occasionally brownish, unchanging, purplish brown beneath the pileipellis. Hymenophore depressed around the stipe, yellow (hardly changing when dried), but with olivaceous tinge when over-mature [Olive-Yellow to Dark Olive-Buff], unchanging or discoloring bluish very slowly; pores 0.5–1(1.5) mm in diam., round to angular, sometimes compound, yellow; tubes yellow, up to 8 mm deep. Stipe 4–8 × 0.3–1 cm, subcylindric to subfusiform; surface whitish, cream to yellowish, often with pinkish tinge, smooth, without nets, sometimes longitudinally fibrillose, gelatinous to strongly viscid especially when young and wet, basal mycelium white.


H20
KOH
20 µm
2
3
4
1
2 cm
10 µm
5
30 µm
6

Figs. 1–6: *Aureoboletus thibetanus*
Basidiocarps; 2. Tube trama, subhymenium, basidia, and pleurocystidia;
3. Cystidia in H_20 and 5% KOH; 4–5. Basidiospores; 6. Stipitipellis.
1–4 from HKAS 41151, 5 from type, 6 from HKAS 38216.
Shaded parts of figs. 2–3 are strongly refractive.

Odor none. Taste mild. Spore print “Light Brownish Olive” to somewhat paler than “Citrine-Drab” [4D5–6 to 4E7–8].

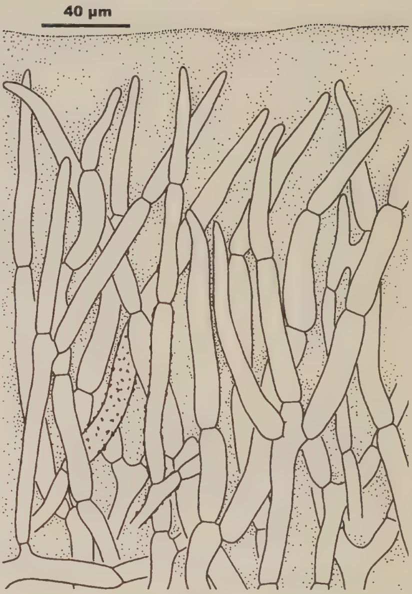


Fig. 7: *Aureoboletus thibetanus* Pileipellis (HKAS 41151).

Tube trama bilateral (Fig. 2). Mediostratum yellowish, composed of branching hyphae 3–10 µm wide, hardly to only slightly gelatinized. Lateral stratum composed of branching hyphae 3–7 (10) µm wide, gelatinized, diverging at an angle of 30°–60° to the mediostratum. Subhymenium ca. 20 µm thick, composed of frequently branching and septate hyphae 3–8 µm wide. Basidia 24–30 × 8–10.5 µm, clavate, 4-spored, rarely 2-spored; sterigmata 3–4 µm long; basal septa without clamps; contents of basidia colorless and hyaline in KOH and Melzer’s reagent, sometimes yellowish in the latter. Spores (Figs. 4–5) (9.0) 9.5–13.0 (15.0) × (4.0) 4.5–5.0 (5.5) µm [Q = 2.1–2.7 (3.0), **Q** = 2.4 ± 0.2], boletoid, inequilateral in side view with a week or distinct suprahilar depression, elliptic-fusiform to subfusiform in ventral view, yellowish in KOH, rarely turning reddish brown in Melzer’s reagent. Pleurocystidia (Figs. 2–3) 30–75 × 4–10 µm (refractive substance on surface excluded), subcylindrical, subfusiform to clavate or irregularly formed, thin-walled, with contents nearly colorless, hyaline in KOH and Melzer’s reagent, sometimes yellowish in the latter; outer surface covered with a 5–8 µm thick layer of strongly refractive (yellowish to yellow, color unchanging in Melzer’s reagent) substance which can quickly and completely be solved in 5% KOH when fresh material studied (Fig. 3). Cheilocystidia similar to pleurocystidia in form and size. Pileipellis (Fig. 7) an ixotrichodermium composed of loosely and more or less vertically arranged (but such arrangements often disrupted when fruitbody dried), frequently septate hyphae 4–8 (12) µm in diam. embedded in a gelatinized matrix, hyphal surface often with yellowish granular incrustations soluble in 5% KOH, sometimes with yellowish to brownish vacuolar pigment; apical elements subcylindrical to lanceolate, 30–80 × 5–8 µm, apical part often narrower. Hyphae of pileal context often with yellow to golden yellow vacuolar pigment. Veil remnants on pileal margin composed of strongly gelatinized filamentous hyphae 3–6 µm in diam., often colorless, hyaline in KOH and Melzer's reagent. Stipitipellis (Fig. 6) an ixotrichodermium, about 250–400 µm thick, composed of branching hyphae 4–7 µm wide, terminal cells 35–50 × 4–8 µm, tips often swollen.

Specimens examined: CHINA. YUNNAN PROVINCE: Kunming, Xishan ("Shishan"), 11-VIII-1942, W. F. Chiu 7851 (HMAS 3851); the same location, 22-VII-1942, W. F. Chiu 7896 (HMAS 3896); Kunming, Heilongtan, under *Quercus acutissima*, 13-VII-1991, M. Zang 11881 (HKAS 23349); Kunming, Heilongtan, Botanical Garden, 1980 m, under *Quercus franchetii*, 4-IX-1999, Z. L. Yang 2633 (HKAS 34077); the same location, 4-VII-2001, F. Q. Yu 425 (HKAS 38216); the same location, 11-VIII-2002, Z. L. Yang 3225 (HKAS 41151); Jianchuan, Shibaoshan, under Fagaceae forest, 19-VIII-1999, X. H. Wang 853 (HKAS 35889); SICHUAN PROVINCE: Kangding ("Tchen-Kéou-Tin"), in 1894, R. P. Farges *s.n.* (Herb. Patouillard, FH 3711-type).

Remarks: Patouillard (1895) described *Boletus thibetanus* from south-western China, without any citation of vouchers. The first author found only a single collection labeled as "*Boletus thibetanus*" in the handwriting of N. Patouillard in the Patouillard herbarium housed in Farlow Herbarium (FH 3711). It is probably the only voucher specimen based on which the name was proposed and, thus, was designated as the type for the taxon by Zang *et al.* (1993). Ying & Zang (1994), and Zang (1996) stressed that the pileus of the type specimen of *A. thibetanus* is smooth, not reticulate. The first author studied the type, which consists of only one fruitbody in very poor condition, and only the spores could be measured. They are [30/1/1] (9.0) 9.5–12.0 × 4.0–5.0 (5.5) µm [Q = 2.1–2.4 (2.7), **Q** = 2.3 ± 0.1]. Whether the pileus is smooth or not couldn't be concluded with certainty from the observation of the dried type specimen. However, Patouillard's original description and illustration clearly showed that the pileal surface is reticulate, and the pileal margin is appendiculate, the characters also observed by Chiu (1948,

1957) and us from the material cited above (see Fig. 1).

Chiu (1948, 1957) described that the pileus was "densely covered with dark-brown-dotted elements." His collections preserved in HMAS (3851, 3879) showed that such "dots" are just the still unexpanded reticulum of a young pileus.

The cystidia of *A. thibetanus* are very characteristic with a thick layer of strongly refractive yellowish to yellow substance on the surface. The substance can completely be dissolved in 5% KOH when fresh material is studied (Fig. 3), but it only partially, especially on the upper two thirds of the cystidia, disappears in 5% KOH when dried material is examined. The contents of the cystidia are nearly colorless, hyaline to subhyaline. The refractive substance might be regarded as the outer layer of the cell wall, but the authors prefer to consider it as being an incrustation on the cell wall of cystidia.

Corner (1972) reported *Boletus thibetanus* from Singapore. Hongo & Nagasawa (1980), and Watling & Hollands (1990) reported *A. thibetanus* from Japan, and Malaysia (Sarawak) respectively. However, according to their descriptions and illustrations, the Singapore, Malaysian and Japanese boletes may not be conspecific with the material described here, because there are a few important discrepancies between the materials collected in southwestern China and Japan, or in southwestern China and Singapore or Malaysia. For example, no reticulate pileus with appendiculate margin, and no thin-walled cystidia with refractive substance on the surface were reported by them. The description of *Boletus thibetanus* from Malaysia given by Corner (1974) is too brief to make reliable judgment. Two colored photos presented as *A. thibetanus* in Imazeki *et al.* (1988: 314) don't represent *Aureoboletus* (Nagasawa, 1997).

Hongo & Nagasawa (1980) and Nagasawa (1997) regarded *Aureoboletus novoguineensis* Hongo as a synonym of *A. thibetanus*. However, Hongo's species has a radially rugose pileus, thin-walled cystidia with golden-yellow contents, and the pileal margin may not be appendiculate (Hongo, 1973).

Mao *et al.* (1993) described *A. thibetanus*, under the name "*Austroboletus thibetanus* (Pat.) Hongo & Nagasawa." Mao (1998) reported *Pulveroboletus thibetanus* (Pat.) Singer from southwestern China. According to their descriptions and illustrations, they may not have dealt with the true *A. thibetanus*. Mao (2000) published a photo under the name

"*Austreoboletus thibetanus* (Pat.) Hongo & Nagasawa." The photo (fig. 830) may be a representative of *Boletellus obscurecoccinus* (Höhn.) Singer. In the same book under the name *Boletellus longicollis* (Ces.) Pegler & T.W.K. Young two photos (figs. 827-1 and 827-2) were published. Fig. 827-2 is *Aureoboletus thibetanus*.

Boletus umbilicatus Massee, a species also with viscid fruitbody and somewhat rugose pileus, is similar to *A. thibetanus* (see Corner, 1972: 136), but can be distinguished from the latter by the smearily zoned stipe, grayish white then olivaceous yellowish hymenophore and thin-walled colorless cystidia.

Aureoboletus reticuloceps M. Zang *et al.*, originally described from southwestern China, also possesses a reticulate pileus (Zang *et al.*, 1993). However, *A. reticuloceps* has a much stouter fruitbody with a dry pileus, a dry stipe with a whitish reticulum, a whitish then yellowish hymenophore, significantly larger spores and lacks gloeocystidia according to our observation on the type and additional material collected recently. Whether it is a member of *Aureoboletus* or not needs studying further.

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The authors are very grateful to the following persons for their kind help and support: Mr. E. Nagasawa, Tottori Mycological Institute, Tottori, who critically reviewed the manuscript; Prof. Dr. D. H. Pfister, Harvard University Herbaria, Cambridge, Massachusetts, who allowed the first author access to the type of *Boletus thibetanus* housed in Farlow Herbarium; Prof. Dr. R. P. Korf, Cornell University, Ithaca, who improved the English; and Dr. R. Halling, New York Botanical Garden, New York, who gave valuable suggestions.

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MYCOTAXON

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RE-DISPOSITIONS OF PHILLIPSIA (PEZIZALES) COLLECTIONS FROM CHINA[*]

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Abstract: Collections of *Phillipsia* from China were re-examined. Corrections of and comments on the previously recorded Chinese species were made and six taxa of the genus are currently recognized, including two new species. They are *P. carnicolor, P. chinensis* sp. nov., *P. costaricensis, P. crenulopsis* sp. nov., *P. domingensis,* and *P.* cf. *hartmannii*. The distinctions between new taxa and the related species were discussed.

Key words: *Phillipsia chinensis, Phillipsia crenulopsis,* corrections, DNA sequence, taxonomy

Phillipsia Berk. is a well-characterized genus in the Pezizales. Members of the genus share the following features: bright-colored, small to large sized fruitbodies that are sessile to subsessile and centrally or eccentrically attached, tissues in the ectal excipulum of *textura intricata*, *textura epidermoidea* to *textura porrecta*, suboperculate asci, commonly unequal-sided ascospores ornamented with longitudinal ribs, striations, wrinkles or smooth-walled. Regional studies on *Phillipsia* have been carried out in Asia, Australasia, Madagascar, North America, Central America, and South America (Seaver, 1928, 1942; Boedijn, 1933, 1940; Le Gal, 1953; Denison, 1969; Paden, 1977; Otani, 1980; Moravec, 1997; Zhuang & Wang, 1997, 1998a, b; Hansen et al., 1999).

The first species of the genus from China was recorded by Teng (1934), i. e. *Phillipsia domingensis* (Berk.) Berk. Two other species, *Phillipsia inaequalis* (Berk. & M.A. Curtis) Le Gal and *P. subpurpurea* Berk. & Broome, were later found (Teng, 1963). *Phillipsia inaequalis* was recorded only from Guangxi Province on decayed wood and with large apothecia 5–6 cm in diam, orange hymenium, oblong-ellipsoid ascospores 21–27 × 10–12 μm and with longitudinal striations on surface; material that matches the description of this fungus seems no longer in existence. *Phillipsia subpurpurea* was also reported from Guangxi, with large apothecia 4–8 cm in diam, purplish red hymenium, ascospores smooth-walled, asymmetrical-ellipsoid and 25–31 × 12–13 μm (Teng, 1963), which is quite possibly based on a mis-identification and was subsequently recorded as *P. crispata* (Berk. & M.A. Curtis) Le Gal (Zhuang &

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Wang, 1997), again a mis-identification. All the above species refer to taxa in *Phillipsia* having large fruitbodies. In recent years, many more collections were gathered from the southern part of China and possess small to medium-sized apothecia. Names like *P. carnicolor*, *P. costaricensis*, *P. hartmannii*, and *P. umbilicata* appeared in the literature (Zhuang & Wang, 1997, 1998a, b). In connection with our recent work on the Chinese Fungus Flora, available material of *Phillipsia* on deposit in the Mycological Herbarium, Institute of Microbiology, Chinese Academy of Sciences (HMAS), Herbarium of Cryptogams, Kunming Institute of Botany, Chinese Academy of Sciences (HKAS) and Herbarium of the National Museum of Natural Science at Taichung (TNM) was re-examined. Corrections of the previous Chinese records are clearly necessary.

TAXONOMY

1. Phillipsia chinensis W.Y. Zhuang, **sp. nov.** 中华歪盘菌 (Figs. 1, 5, 9)

Ab *Phillipsia domingensi* et *Phillipsia crispata* differt ascosporis (7–)8–11-striatis, (20.5–)23–28(–30) × (10.2–)11–14 μm. Ab *Phillipsia costaricensi* differt ascosporis asymmetricis, biguttulatis, (7–)8–11-striatis, magnis; hymeniis rufopurpureis.

Apothecia solitary to gregarious, discoid, centrally or eccentrically attached, 10–50 mm in diam, receptacle very thick (up to 9 mm thick when dry), corky to slightly leathery, sessile to substipitate; hymenium purplish red to dirty purplish red when fresh, sometimes with cream-colored patches, upon drying yellowish brown, reddish brown to light dirty red; receptacle yellow pink to pink when fresh, upon drying dirty yellow, pink, pinkish yellow to light reddish brown; ectal excipulum of textura epidermoidea with short hyphal protrusions on surface, 50–88 μm thick, cells hyaline, up to 21.5 × 12 μm; medullary excipulum of textura intricata, with a very dense layer in the middle, 240–5000 μm thick or thicker; subhymenium of dense textura intricata, well-developed, 40–80 μm thick; hymenium ca 330–450 μm thick; asci subcylindrical, narrower at base, 8-spored, J– in Melzer's reagent, 11–17 μm wide; ascospores asymmetrically ellipsoid, slightly pointed at ends, with (7–)8–11 striations on one side, with (1–)2 large guttules, uniseriate, (20.5–)23–28(–30) × (10.2–)11–14 μm; paraphyses filiform, often branched apically, 2–3 μm wide.

Holotype: China. Sichuan: Dujiangyan, on rotten twigs, 1999 X 4, Z.L. Yang 2781, HMAS 76094.

Other specimens examined: Jiangxi: Jinggangshan, on dead twig, 1996 X 26, Z. Wang & W.Y. Zhuang 1548, HMAS 71906. Hubei: Shennongjia, on dead wood, 1984 VIII 29, S.X. Sun & X.Q. Zhang 807, HMAS 71866. Hunan: Badagongshan, 1994 IX 25, S.C. He, HMAS 71941. Guangxi: Longlin, on rotton wood, 1957 X 26, L.W. Xu 1517, HMAS 23952; on rotten wood, 1957 XI 5, L.W. Xu 789, HMAS 27732; on rotten wood, 1957 X 24, L.W. Xu 386, HMAS 27733; on rotten wood, 1957 X 19, L.W. Xu 39, HMAS 27850. Guizhou: Ceheng, on rotten wood, 1958 IX 7, Q.Z. Wang 321, HMAS 27731; Chishui, on rotten wood, 1993 X 12, S.C. He, HMAS 71944; Fanjingshan, on rotten wood, 1993. IX 5, M.H. Liu, HMAS 71890; on dead wood, 1993 IX 16, M.H. Liu, HMAS 71879. Xizang: Dongjiu, on rotten wood, 1976 IX 11,

M. Zang, HKAS 5766, HMAS 70321; Nanjiabawa, on rotten wood, 1984 X 4, X.L. Mao 743, HMAS 76084.

Notes: *Phillipsia chinensis* occurs commonly in the southern part of China. The combination of large-sized fruitbodies, purplish red hymenium, very thick excipular tissues up to 9 mm thick upon drying, and asymmetrical-ellipsoid ascospores (20.5–)23–28(–30) × (10.2–)11–14 µm and with 7–11 longitudinal striations distinguishes this fungus from any other species of the genus.

The previous Chinese record of *P. subpurpurea* (Teng, 1963) is quite possibly based on a mis-identification of *P. chinensis* and specimens under that name on deposit in HMAS do not match *P. subpurpurea* in presence of more striations on spore surface, 7–11 instead of 4–6(–7) ribs. It is also similar to *P. crispata* to which it was later mistakenly assigned (Zhuang & Wang, 1997) due to its having more and somewhat finer striations on the spore surface than *P. subpurpurea* does. The Chinese collections have a similar spore size to *P. crispata* reported by Hansen et al. (1999) but smaller than that described by Denison (1969); the number of striations on the spore surface is certainly less than those of *P. crispata* stated by both authors (Hansen et al., 1999; Denison, 1969) (7–11 vs. 15–18 and 10–14 striations on a side). The above features make the Chinese fungus a separate species from either *P. crispata* or *P. subpurpurea*. *Phillipsia chinensis* is also similar to *P. costaricensis* in number of striations on spore surface, but the latter differs in the smaller, symmetrical, uniguttulate ascospores and the color of hymenium surface.

Beside the above morphological evidence, both strands of the rDNA ITS1-5.8S-ITS2 region of *Phillipsia chinensis* (HMAS 76094) were sequenced by using ITS4 and ITS5 as primers (White et al., 1990). The sequence of ca 580 bp was analyzed together with those of the related species from GenBank (Table 1). Sequences were aligned with Clustal W (Thompson et al., 1994), positions with gaps were excluded, and a neighbor-joining tree was created with *Nanoscypha tetraspora* as the outgroup and with bootstrap values from 1000 replicates. The phylogenetic tree indicates that the *Phillipsia* species tested are monophyletic. The *P. domingensis* complex together with *P. lutea* Denison represents a lineage as also stated by Hansen et al. (1999). *Phillipsia chinensis* is clearly distinguished from *P. domingensis* and *P. crispata* and stands as a separate taxon in the genus (Fig. 15).

2. Phillipsia crenulopsis W.Y. Zhuang, **sp. nov.** 拟波缘歪盘菌 (Figs. 2, 6, 10)

Ab *Phillipsia crenulata* marginibus apothecii planis; ascosporis 6–7-striatis, 16–20 × 8.7–11 µm; ornamentis superficierum sporarum (SEM) dissimilibus differt.

Apothecia discoid, 3–12 mm in diam, substipitate to subsessile, centrally or eccentrically attached; hymenium surface orange red to orange-colored when fresh, receptacle surface somewhat paler than hymenial surface; ectal excipulum of textura epidermoidea, sometimes with small pustules on surface, 25–65(–70) µm thick excluding the pustules; pustules 5–23 µm high, appearing small celled textura angularis, cells 2–6 µm in diam; medullary excipulum of textura intricata, ca 40–450 µm thick, cells immediately inside the ectal excipulum more or less perpendicular to the outer surface, hyphae hyaline, 2–8 µm wide; subhymenium 25–38 µm thick;

hymenium 180–235 μm thick; asci subcylindrical, 8-spored, J– in Melzer's reagent, 160–220 × 11.5–14 μm; ascospores ellipsoid, asymmetrical, hyaline, unicellular, biguttulate, uniseriate, with 5–7 longitudinal striations on surface viewed on one side under light microscope, with 6–7 striations clearly shown in SEM study which are sometimes not completely parallel but somewhat irregular or branched, 16–20 × 8.7–11(–12.5) μm; paraphyses filiform, 2–3 μm wide.

Holotype: China. Yunnan: Mengla, Menglun Natural Reserve, on rotten wood, 1990 IX 2, Z.L. Yang 1243, HKAS 22752, HMAS 71950 (isotype).

Other specimens examined: Yunnan: Mengla, Menglun Natural Reserve, on rotten wood, 1990 IX 2, Z.L. Yang, HKAS 22751, HMAS 82131; Mengla, Mengyang, alt. 850 m, on dead twig embedded in soil, 1999 X 21, W.Y. Zhuang & Z.H. Yu 3177, HMAS 78128; Mengla, Menglun Natural Reserve, alt. 460 m, on rotten wood, W.Y. Zhuang & Z.H. Yu 3053, HMAS 81396; Mengla, Bubang, 650 m, on hard wood, Z.H. Yu & W.Y. Zhuang 3091, HMAS 81397.

Notes: Among the Chinese species of *Phillipsia* that have small fruitbodies, *Phillipsia crenulopsis* is the most common one in tropical Yunnan. As mentioned by several authors, species of *Phillipsia* possessing small fruitbodies and small ascospores are not clearly defined (Rifai, 1968; Moravec, 1997; Hansen et al., 1999). *Phillipsia crenulata* (Berk. & Broome) Le Gal originally described from Sri Lanka and *P. umbilicata* from Indonesia are morphologically similar to the new species. *Phillipsia crenulopsis* is similar to *P. crenulata* in size of apothecia, color of hymenium surface, and number of striations on spore surface but differs from the type material of *P. crenulata* in apothecia with an even margin instead of a crenulate one (Le Gal, 1953) and a different spore surface morphology in SEM study (Moravec, 1997). It is distinguished from *P. umbilicata* in hymenium orange to orange red instead of Coral red (Ridgway, 1912) and ascospores clearly striate instead of smooth-walled (Boedijn, 1940).

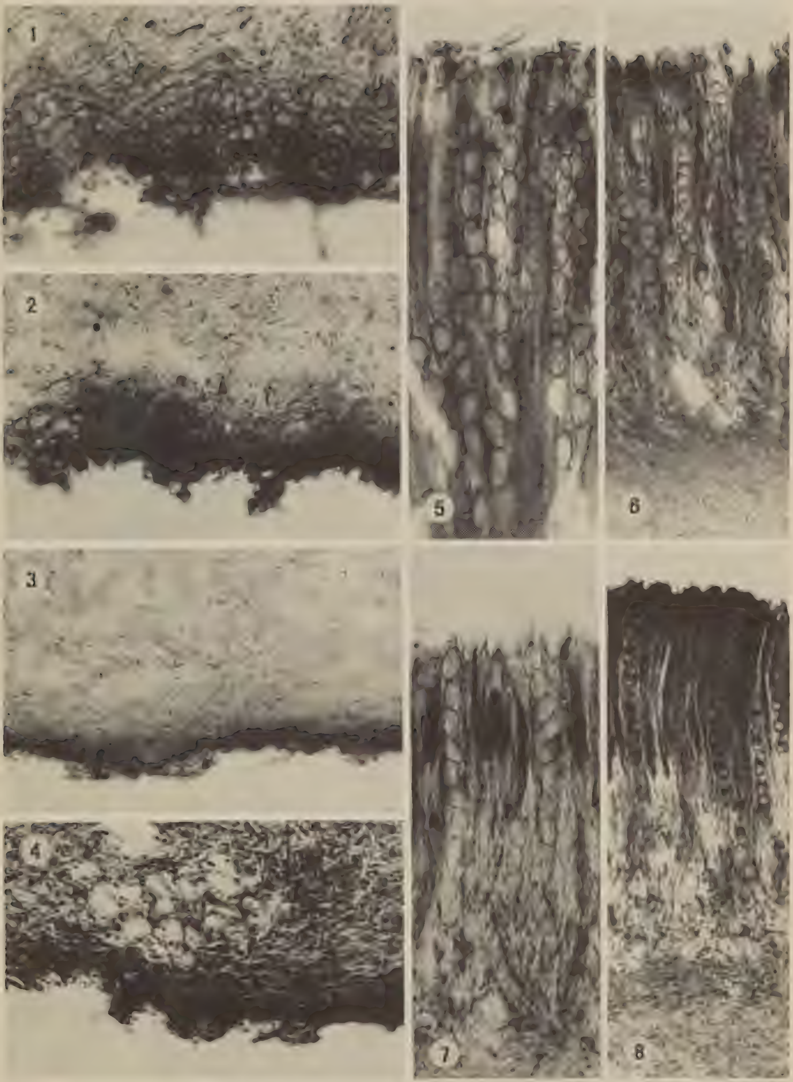
Two of the Chinese collections, HKAS 22751 and 22752, were previously treated as *P. umbilicata* (Penz. & Sacc.) Boedijn due to the size of apothecia and of ascospores, but the low striations on the spore surface were overlooked (Zhuang & Wang, 1998b).

3. Phillipsia carnicolor Le Gal, Prodr. Fl. Mycol. Madagascar 4: 281, 1953.
(Figs. 3, 7, 11-12)

Specimen examined: Yunnan: Xishuangbanna, on rotten twig, 1988 X 23, R.P. Korf, M. Zang, K.K. Chen & W.Y. Zhuang 253, HMAS 70083.

Known distributions: China, Madagascar, Thailand.

Notes: The species was originally described from Madagascar (Le Gal, 1953) and later collected in China and Thailand (Zhuang & Wang, 1997; Hansen et al., 1999). It is characterized by its small apothecia 5–10 mm in diam, scarlet to red hymenium when fresh, ellipsoid ascospores symmetrical or slightly asymmetrical, 17–19.5 × 9.5–11.5(–12) μm, with blunt ends and 7–10 fine striations on a side. The longitudinal striations are either parallel or somewhat branched. Hansen et al. (1999) provided an SEM illustration to show the ascospore surface morphology. It is distinguishable from



Figs. 1-8. Structure of *Phillipsia* spp. 1-4. Ectal excipulum: 1. *P. chinensis*; 2. *P. crenulopsis*; 3. *P. carnicolor*; 4. *P.* cf. *hartmannii.* 5-8. Portion of hymenium: 5. *P. chinensis*; 6. *P. crenulopsis*; 7. *P. carnicolor*; 8. *P.* cf. *hartmannii.* 1, 5 from HMAS 76094; 2, 6 from HMAS 81396; 3, 7 from HMAS 70083; 4, 8 from 71938. All ×240.

P. crenulata in apothecia not crenate at margin, hymenium surface scarlet, and ascospores mostly symmetrical. Among the four Chinese collections previously cited under *Phillipsia carnicolor* (Zhuang & Wang, 1997), HMAS 70083 is the only known collection of this species in China. It is thus not common.

4. Phillipsia costaricensis Denison, Mycologia 61: 300, 1969.

Specimen examined: Yunnan: Xishuangbanna, Menglun Natural Reserve, on dead twigs, 1995 VIII 12, S.H. Wu & J.Y. Tseng 9508-218, TNM-F0003707.

Known distributions: China, Costa Rica.

Notes: This species is not common in China. So far, TNM-F3707 is the only known collection. The fungus is characterized by the medium sized apothecia (ca. 11 mm diam when dry), yellowish cinnamon colored hymenium when dry, symmetrical, ellipsoid, uniguttulate ascospores with pointed ends and 8–10 longitudinal striations on surface on one side, 19.7–23.5 × 10.7–12 μm.

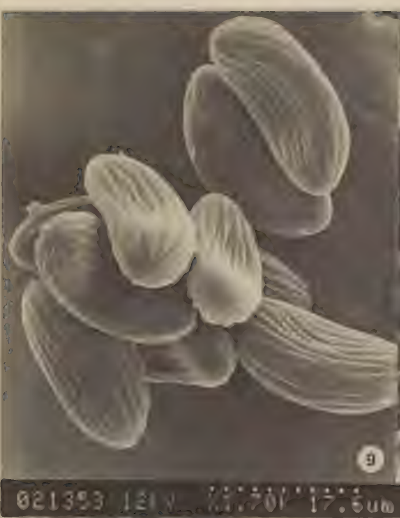
5. Phillipsia domingensis (Berk.) Berk., J. Linn. Soc. Bot. London 18: 388, 1881.

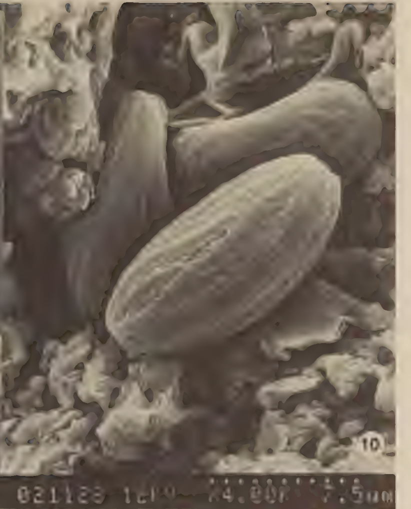
Specimens examined: Guangdon: Dinghushan, on rotten wood, 1981 IX 11, T.H. Li et al., HMIGD 5559; Huidong, Gutian, on twig, 1986 IX 26, G.Y. Zheng, HMIGD 11147. Guizhou: on twig, 1990 VI 6, HMAS 59515; Maolan, on twigs, 1988 VIII 1, Y. Li, Y.C. Zong & J.Z. Ying 555, HMAS 59539, 59540, 59541; on twigs, 1988 VIII 6, Y. Li, Y.C. Zong & J.Z. Ying 558, HMAS 59552, 59556; on twig, 1988 VIII 7, Y. Li, Y.C. Zong & J.Z. Ying 559, HMAS 59555; Suiyang, on rotten wood, 1986 IX 2, M.H. Liu 993, HMAS 71888. Taiwan: Nantou, 1992 VIII 2, S.H. Wu, TNM-F0674. Yunnan: Mengla, Menglun, on twig, 1990 VIII 25, Z.L. Yang 1173, HKAS 23294; ibid., 1991 VIII 9, Z.L. Yang 1496, HKAS 24015; Mengla, Cuipingfeng, 1995 VIII 11, Z.L. Yang 2159, HKAS 29448; Xishuangbanna, on twig, 1985 VIII 21, Q.X. Wu 584, HMAS 70116; ibid., 1988 X 23, R.P. Korf, M. Zang, K.K. Chen & W.Y. Zhuang 252, HMAS 70117; ibid., 1988 X 22, R.P. Korf, M. Zang, K.K. Chen & W.Y. Zhuang 218, HMAS 72074.

Known distributions: Brazil, China, Costa Rica, Domingo, Ecuador, Guadeloupe, Jamaica, Japan, Madagascar, Mexico, Puerto Rico, Thailand, United States.

Notes: This is the most common species in the tropical and subtropical regions of China and widespread in the world. It is characterized by large fruitbodies, reddish purple to purplish hymenium surface, and ascospores with 3–5 coarse, longitudinal ridges on the surface, 21.5–26.5(–30) × 11.5–14(–15) μm. Hansen et al. (1999) studied several species of the genus from the morphological and molecular points of view. Their results indicated that the so-called *Phillipsia domingensis* is possibly a species complex and that hymenium color varied among collections.

Figs. 9-14. Ascospore surface morphology (SEM) of *Phillipsia* spp.: 9. *P. chinensis,* HMAS 70321; 10. *P. crenulopsis,* from HMAS 78128; 11-12. *P. carnicolor,* from HMAS 70083; 13-14. *P.* cf. *hartmannii,* 13 from HKAS 23280, 14 from HMAS 28976.


9
021353 12KV X1.70K 17.6um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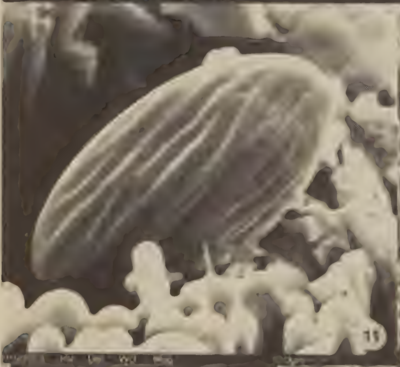
021128 12KV X4.00K 7.5um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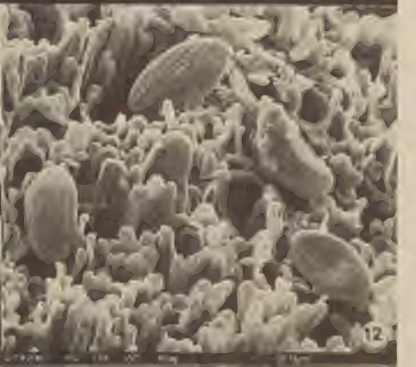
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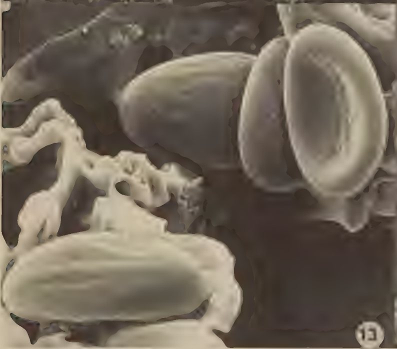
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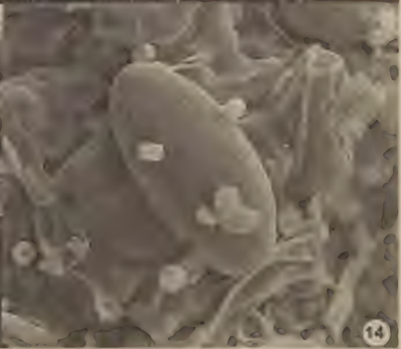
14

Table 1. Material used in phylogenetic study

Species	Locality	GenBank
Phillipsia carnicola	Thailand	AF117353
P. chinensis	China	AY254710
P. crispata	Ecuador	AF117354
P. crispata	Ecuador	AF117355
P. domingensis	Brazil	AF117371
P. domingensis	Costa Rica	AF117358
P. domingensis	Ecuador	AF117359
P. domingensis	Puerto Rico	AF117356
P. domingensis	Thailand	AF117373
P. lutea	French Guiana	AF117374
P. olivacea	Venezuela	AF117376
P. olivacea	Ecuador	AF117377
Nanoscypha tetraspora	Puerto Rico	AF026310

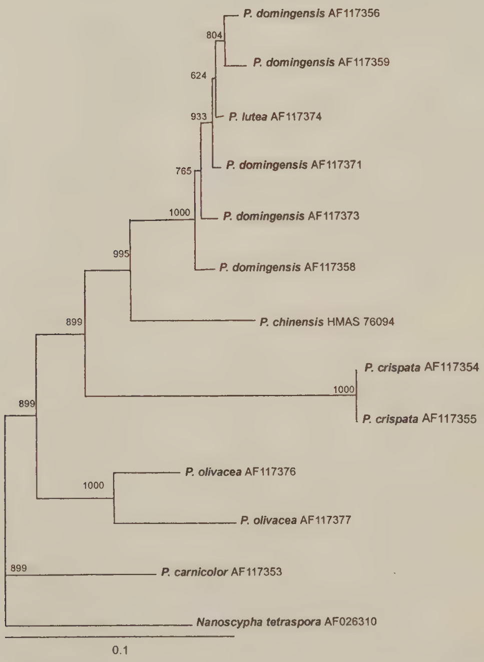
P. domingensis AF117356
804
P. domingensis AF117359
624
933
P. lutea AF117374
P. domingensis AF117371
765
1000
P. domingensis AF117373
995
P. domingensis AF117358
899
P. chinensis HMAS 76094
P. crispata AF117354
1000
899
P. crispata AF117355
P. olivacea AF117376
1000
P. olivacea AF117377
899
P. carnicolor AF117353
Nanoscypha tetraspora AF026310
0.1

Fig. 15 Neighbor-joining tree showing the phylogenetic relationship of some species in *Phillipsia* based on sequences of ITS1-5.8S-ITS2 region with *Nanoscypha tetraspora* as the outgroup with bootstrap values from 1000 replicates.

In the Chinese collections with large apothecia and reddish to purplish hymenium, two distinct taxa are recognized according to the spore surface morphology. One is represented by presence of 3–5 coarse, longitudinal ridges on one side of spore and the other is of 7–11 low and fine striations on spore surface. The former is obviously *P. domingensis*, while the latter is *P. chinensis*.

6. Phillipsia cf. **hartmannii** (W. Phillips in Cooke) Rifai, Verh. Kon. Ned. Akad. Wetensch., Afd. Natuurk., II, 57(3): 50, 1968. (Figs. 4, 8, 13-14)

Specimens examined: Hainan: Qiongzhong, on rotten wood, 1960 IX 15, J.H. Yu 2127, HMAS 28976. Yunnan: Mengla, Mongyang, on hard wood, 1988 X 23, R.P. Korf M. Zang & W.Y. Zhuang 254, HMAS 70084; Mengla, Menglun, on rotten wood, 1974 VIII 31, M. Zang, HKAS 1016, HMAS 70312; Xishuangbanna, on small twig, 1988 X 22, R.P. Korf, M. Zang, K.K. Chen & W.Y. Zhuang 231, HMAS 71938; Mengla, Menglun, on rotten bamboo culms, 1990 VIII 23, Z.L. Yang 1152, HKAS 23305, HMAS 71951; Mengla, Menglun, on rotten wood, 1990 VIII 20, Z.L. Yang 1123, HKAS 23280, HMAS 71971; Mengla, on rotten wood, 1998, Z. Wang & P.G. Liu 2255, HMAS 75910; on rotten wood, 1995 VIII, Wu 9508-307, TNM-F3711.

Known distributions: Australia, China.

Notes: In the Chinese collections observed, three distinct taxa can be recognized. Two of them, *Phillipsia carnicolor* and *P. crenulopsis*, show faint striations on ascospore surface under light microscope and distinct, longitudinal striations in SEM study. Mature ascospores of the third species, *P. hartmannii*, appear smooth-walled under the light microscope and nearly smooth to somewhat roughened or occasionally with faint, irregular ornamentations visualized only by SEM. The apothecia of *P. hartmannii* are usually less than 9 mm (occasionally up to 25 mm) in diameter and sessile to subsessile, hymenium surface is scarlet to reddish orange when fresh, ectal excipulum of textura porrecta with short free hyphal endings on surface, and ascospores are symmetrical or asymmetrical, biguttulate and 17–21(–22) × 9.5–11.5 µm. Since the ectal excipular structure of the Chinese material does not match that described by Rifai (1968) as textura intricata, the above collections are tentatively treated as *Phillipsia* cf. *hartmannii*.

A KEY TO THE KNOWN SPECIES OF *PHILLIPSIA* FROM CHINA

1. Apothecia usually over 20 mm in diam; ascospores longer than 21 µm 2
1. Apothecia usually less than 20 mm in diam; ascospores shorter than 21 µm 3

    2. Ascospores with 3–5 coarse striations on one side .... ***P. domingensis***
    2. Ascospores with finer striations, 7–11 striations on one side .... ***P. chinensis***
3. Ascospores nearly smooth-walled under light microscope .... ***P.*** cf. ***hartmannii***
3. Ascospores with 6–8 or more striations viewed from one side 4
    4. Ascospores symmetrical, uniguttulate, somewhat pointed at ends
    .... ***P. costaricensis***
    4. Ascospores asymmetrical-ellipsoid, usually biguttulate 5

5. Hymenium surface scarlet to red; ascospores ellipsoid, symmetrical or slightly asymmetrical, 7–10 fine striations seen on one side, 17–19.5 × 9.5–11.5(–12) µm .... ***P. carnicolor***

5. Hymenium surface mostly reddish orange; ascospores asymmetrical, 6—8 striations seen on one side, 16–20 × 8.7–11 µm .... ***P. crenulopsis***

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TYPE STUDIES OF NEOTROPICAL COLLYBIA SPECIES

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ABSTRACT

Current morphological and molecular research supports segregation of *Gymnopus* and *Rhodocollybia* from *Collybia.* Recent taxonomic studies with neotropical agarics to which the genus name *Collybia* has been applied led to the examination of several type specimens. Diagnostic micromorphological characteristics were used to assess taxonomic placement of each type. Five new combinations under *Gymnopus* are proposed.

Key words: generic concepts, nomenclature, Tricholomataceae, type species

INTRODUCTION

Mycologists trying to follow concepts of *Collybia sensu* Fries (1821, 1838) have compiled different and improved understandings of this name (Kühner and Romagnesi, 1953; Métrod, 1952; Singer, 1986). Fries' broad concept of *Collybia*, based on few distinctive macroscopic characters, is represented in many genera in the family Tricholomataceae, in which basidiomata may display a wide range of phenotypic variation making identification based on relatively few field characters very difficult. Current positive identification of *Collybia sensu lato* and allied taxa includes the use of micromorphology, as well as biochemical and staining reactions, substrate description (Antonín and Noordeloos, 1993, 1997; Antonín et al., 1997; Halling, 1983; Lennox, 1979; Singer, 1986), and more recently, phylogenetic signaling (Moncalvo et al., 2002).

Recently, Antonín et al. (1997) proposed restriction of generic circumscription of *Collybia* by more stringently defining its characters. They suggested dividing *Collybia* into three genera, namely *Collybia*, *Gymnopus*, and *Rhodocollybia.* The concept of *Collybia* was reduced to represent those small collybioid mushrooms fruiting on mummified basidiomata of *Russula* and *Lactarius* or with a stipe growing from a sclerotium as represented by its type species, *C. tuberosa* (Bull.: Fr.) Kummer (Antonín and Noordeloos, 1997; Antonín et al., 1997, Hughes et al., 2000). The genus *Gymnopus,* with *G. fusipes* (Bull.: Fr.) S. F. Gray as its type species, became what was typically understood as those collybioid mushrooms comprising species mainly from *Collybia* sect. *Vestipedes*, *Levipedes*, *Subfumosae,* and *Iocephalae* (*sensu* Singer, 1986). *Rhodocollybia*, with *R. maculata* (Albert. & Schw.: Fr.) Singer as the type, was proposed for species with pinkish colored, pseudoamyloid spores (*Gymnopus* sect. *Striipedes sensu* Singer, 1986).

Much of the present knowledge and application of the name *Collybia* to neotropical taxa is based on regional mycofloras (Dennis, 1970; Guzmán, 1979; Pegler, 1983). Species descriptions of these neotropical *Collybia*, however, exhibit morphological characteristics that are more similar to modern concepts of *Gymnopus*, and a revision of their taxonomical status became evident during recent taxonomic and systematic research (Mata, 2002). The objective of this paper is to report on some type specimens studies of names currently combined in *Collybia* or that are suspected of belonging in *Gymnopus*.

MATERIALS AND METHODS

Morphological observations. All macroscopic observations were performed on dried material. Sections of basidiomata were rehydrated in 95% aqueous solution of ethanol, and then placed in 3% aqueous KOH. Preparations were observed under phase contrast and/or bright field microscopy with Congo Red. Melzer's (IKI) reagent was used to test amyloidity. For the purpose of brevity, macroscopic descriptions made by the original authors are not included in this paper.

Terminology. Basidiospore measurements and statistics are as follow: range of spore length X spore width (in µm) is given for all measured basidiospores; n = the total number of spores measured, x = the arithmetic mean of spore length and spore width for all spores measured; Q = the spore length divided by spore width, indicated as a range of variation in n spores measured; Qx = the arithmetic mean of Q-values. Color names followed by alphanumerical codes in parenthesis are from Kornerup and Wanscher (1978).

RESULTS

CLITOCYBE COLLYBIOIDES Spegazzini, Bol. Acad. Nac. Ci. 11(4): 387. 1889.
Holotype: BRAZIL, Apiahy, IV. 1888, coll. J. Puiggari no. 2893 (LPS) [!].
≡ *Collybia collybioides* (Speg.) Singer, Lilloa 23: 162. 1950(1952).
≡ *Gymnopus collybioides* (Speg.) Desjardin, Halling & Hemmes, Mycologia 91: 175. 1999.

Basidiomata in poor preservation condition. **Pileus epicutis** a simple cutis; hyphae up to 10 µm diam, repent, radially oriented, hyaline, with clamp connections; wall thin. **Pileus trama** interwoven; hyphae up to 14 µm diam, hyaline, yellowish to pale orange in IKI; wall thin. **Lamellar trama** irregular; hyphae up to 6 µm diam, hyaline, yellowish to orangish in IKI; wall thin. **Basidia** (Fig. 1a) 16-18 X 4-5 µm, narrowly clavate; sterigmata four; basidioles similarly sized as basidia, cylindrical to submucronate. **Pleurocystidia** none. **Cheilocystidia** (Fig. 1b) 17-27 X 5-11 µm, clavate, sphaeropedunculate, occasionally flexed and knobbed. **Stipe epicutis** and **caulocystidia** not studied. Clamp connections present in all tissues.

Basidiospores (Fig. 1c) 5.6-7.2 X 2.4-4.0 μm (n = 8, x = 6.3 X 3.3 μm, Q = 1.60-2.33, Qx = 1.92), ellipsoid or lacrymoid in side view, ellipsoid in profile, hyaline, inamyloid; wall thin, smooth.

Commentary: The type specimen of *C. collybioides* is in poor condition and in need of epitypification; all tissues are highly mold-contaminated. Spores were few and difficult to distinguish from contaminants, and cystidia were hard to find due to wearing off of the lamellar margin. The pileus epicutis, however, is definitively a simple cutis, and the combination with other microscopic elements leads us to agree with placement under *Gymnopus*. Following current taxonomic treatment of *Gymnopus* (Antonín and Noordeloos, 1997; Halling, 1983) *G. collybioides* belongs in sect. *Vestipedes*.

Singer's (1950) concept of this species was near to *G. confluens* (Pers.: Fr.) Antonín et al., which is the type species of section *Vestipedes* (Antonín and Noordeloos, 1997). Desjardin et al. (1999) considered it to be morphologically related to *G. subcyathiformis* (see details below) and to *G. menehune* Desjardin et al. from the Hawaiian Islands. In nature, basidiomata of *G. collybioides* are similar to those of *G. biformis* (Pk.) Halling from temperate North America in that they share small stature and gregarious fruiting on leaf litter in deciduous forests, while microscopically the dimensions and shape of basidiospores, cheilocystidia, and pileus epicutis are very similar (Mata, 2002).

MARASMIUS FIBROSIPES Berkeley and Curtis, J. Linn. Soc. (Bot.). 10: 293. 1868.
Holotype: CUBA. Wright 89 (K) [!].
≡ *Collybia fibrosipes* (Berk. & Curt.) Dennis, Trans. Brit. Mycol. Soc. 34: 448. 1951.

Basidiomata two, flat-pressed, glued to cardboard; condition of preservation poor. **Pileus** 12-17 mm diam, ± circular; surface characteristics not observable; margin inrolled, even. **Lamellae** seceding, thin, ± broad, close to subdistant, light brown; margin smooth. **Stipe** up to 20 X 3 mm, central, terete, equal; surface striate, sulcate, appearing scaly.

Pileus epicutis a cutis; hyphae 2-6 μm diam, cylindrical, radially oriented, hyaline, yellow orange in IKI; wall thin. **Pileus trama** interwoven; hyphae up to 14 μm diam, hyaline; wall thin. **Lamellar trama** disposition not determined; hyphae 2-4 μm diam, hyaline; wall thin. **Basidia** (Fig. 2a) and basidioles collapsed, 14-16 X 5-6 μm, clavate. **Pleurocystidia** absent. **Cheilocystidia** (Fig. 2b) few, 24-32 X 6-8 μm, clavate, sometimes lobed or knobbed. **Stipe epicutis** parallel; hyphae 2-8 μm diam, cylindrical, yellowish in mass, hyaline singly; wall thin to 0.8 μm thick. **Caulocystidia** not observed; probably obscured by contaminants. Clamp connections present in all tissues.

Basidiospores (Fig. 2c) 4.8-6.4 X 2.4-3.6 μm (n = 25, x = 5.4 X 3.2 μm, Q = 1.63-2.14, Qx = 1.80), lacrymoid to ellipsoid in side view, ellipsoid in profile, hyaline, inamyloid; wall smooth, thin.

Commentary: The combination of macroscopic characteristics with a simple cutis and ellipsoid spores make this specimen a good candidate for placement under

Gymnopus, based on current taxonomic treatment of the genus (Antonín and Noordeloos, 1997). Although presence of cheilocystidia is not a constant characteristic in *Gymnopus* (Antonín and Noordeloos, 1997; Halling, 1983), due to extirpation, these are at best suspected in the type specimen of *M. fibrosipes* because of poor preservation conditions (Mata and Petersen, 2001). A lignicolous habit of basidiomata of the type specimen seems to be shared with those of neotropical *Collybia pseudo-omphalodes* Dennis and temperate *G. luxurians* (Pk.) Murrill and *G. dichrous* (Berk. & Curt.) Halling (Mata, 2002).

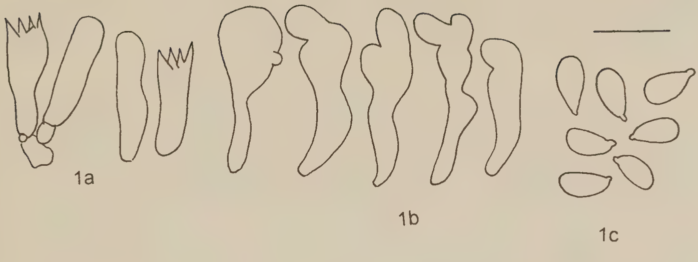
HELIOMYCES HONDURENSIS Murrill, N. Amer. Fl. 9: 248. 1915.
Holotype: BELIZE, 1906. Coll. M.E. Peck (NY) [!].
≡ *Marasmiellus hondurensis* (Murr.) Singer, Beih. Nova Hedw. 14: 47. 1973.

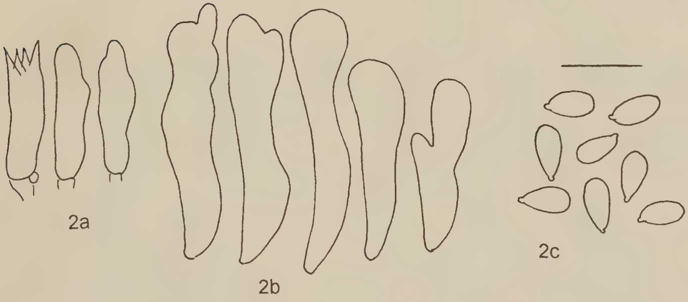
Basidiomata two, in fair condition, broken. **Pileus** expanded, translucent, light brown to ochre. **Lamellae** distant, narrow. **Stipe** finely pruinose, blackened towards base, cartilaginous.

Pileus epicutis a simple cutis; hyphae 2-8 µm diam, cylindrical, not diverticulate, repent, ± interwoven, radially oriented, light brown in mass, hyaline singly; wall thin. Terminal cells 12-44 X 10-16 µm, clavate to submucronate, semi-erect or prostrate. **Pileus trama** interwoven to ± radially oriented; hyphae 4-18 µm diam, cylindrical to somewhat inflated, hyaline; wall thin. Gleoplerous hyphae common, up to 6 µm diam. **Lamellar trama** subregular; hyphae 2-12 µm diam, hyaline; wall thin. **Basidia** (Fig. 3a) 28-36 X 8-9 µm, clavate; sterigmata four, sometimes two; basidioles 24-28 X 5-8 µm, clavate to subumbonate. **Pleurocystidia** absent. **Cheilocystidia** not observed. **Stipe epicutis** parallel; hyphae 2-12 µm, cylindrical, light brown in mass, hyaline singly; wall up to 2 µm thick. **Caulocystidia** rare to occasional, mostly cylindrical, solitary. All tissues inamyloid and with clamp connections present.

Basidiospores (Fig. 3b) 6.4-8.0 X 3.6-4.8 µm (n = 10, x = 7.3 X 4.0 µm, Q = 1.67-2.11, Qx = 1.83), broadly ellipsoid, lacrymoid in side view, ellipsoid in profile, hyaline, inamyloid; wall smooth, thin.

Commentary: Murrill (1915) applied the genus name *Heliomyces* to those species with basidiomata exhibiting some kind of gelatinization. *Heliomyces* has been considered a synonym under *Marasmius* (Antonín and Noordeloos, 1993; Singer, 1986) and the microscopic characteristics of the type specimen of *H. hondurensis* include a simple pileus cutis and hyaline spores which make it a good candidate for placement under *Gymnopus*. Basidiomata of *H. hondurensis* were reported to fruit on wood like those of the types of *M. fibrosipes*, *G. oculatus*, and *M. polygrammus*. According to Dennis (1951), *H. hondurensis* is a synonym under *M. polygrammus*. Dimensions of basidia and basidiospores in both types are very similar, but other microscopic elements are less so. When describing *Marasmiellus hondurensis*, Singer (1973) included versiform diverticulate-cheilocystidia and a pileus epicutis without a true Rameales-structure, characters not observed in our study of the type specimen.





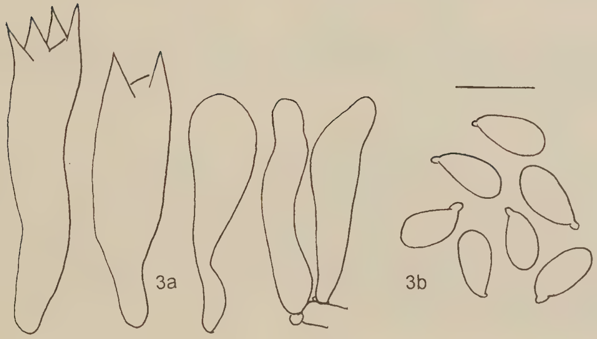


Fig. 1. Micromorphology of *Clitocybe collybioides*. a. basidia and basidioles; b. cheilocystidia; c. spores. Scale bar = 10 µm.

Fig. 2. Micromorphology of *Marasmius fibrosipes*. a. basidium and basidioles; b. cheilocystidia; c. spores. Scale bar = 10 µm.

Fig. 3. Micromorphology of *Heliomyces hondurensis*. a. basidia and basidioles; b. spores. Scale bar = 10 µm.

COLLYBIA LODGEAE Singer, Fieldiana, Botany n.s. 21: 23. 1989.
Holotype: COSTA RICA. Provincia de Heredia, Sarapiquí, near Puerto Viejo, La Selva OTS Biological Station, Research Trail, on large rotten cut log, 23.XII.1979, Lodge 294, (F) [!].

Basidiomata three, in good condition. **Pileus** 10-20 mm diam, convex to applanate, sometimes centrally depressed; surface fibrillose to glabrescent, strongly hygrophanous, sulcate almost entirely, translucent, light brown at center, reddish brown towards margin; margin sulcate, translucent; context less than 1 mm thick. **Lamellae** adnate with a decurrent tooth, narrow, subdistant to distant, dark reddish brown, darker than pileus; margin smooth; lamellulae in one tier. **Stipe** 30-50 X 2-3(4) mm, central, ± equal or ± broadening at apex, twisted, base sometimes bent and tapering; surface fibrillose, sulcate, dark brown to black towards base, covered with a downy, light, white pubescence.

Pileus epicutis a cutis; hyphae radially oriented, filamentous; gleoplerous hyphae present. **Pileus trama** interwoven; hyphae 4-12 µm diam, hyaline. **Lamellar trama** ± regular; hyphae 4-12 µm diam, hyaline. **Basidia** (Fig. 4a) 24-32 X 6-7 µm, clavate, sterigmata four; basidioles similarly sized, narrowly clavate. **Pleurocystidia** (Fig. 4b) 42-56 X 10-12 µm, mostly fusoid ventricose, submucronate to mucronate at apex; arising from tramal hyphae. **Cheilocystidia** (Fig. 4c) abundant, sometimes prostrate and collapsed, 32-56 X 10-14 µm, mostly broadly fusoid-ventricose, occasionally long and clavate, often with a diverticulate outgrowth, arising from horizontal hyphae. **Stipe epicutis** parallel; hyphae 2-14 µm diam, cylindrical, yellowish in mass, hyaline singly; wall up to 2 µm thick. **Caulocystidia** up to 40 X 9 µm, cylindrical, clavate, to subfusoid, arising directly from upper hyphae. All tissues inamyloid and with clamp connections present.

Basidiospores (Fig. 4d) 6.8-8.8 X 3.2-4.4 µm (n = 20, x = 7.5 X 3.7 µm, Q = 1.80-2.22, Qx = 2.03), lacrymoid to ellipsoid in side view, ellipsoid in profile, hyaline, inamyloid; wall smooth, thin.

Commentary: When proposing this new species, Singer (1989) offered only a detailed Latin diagnosis. Observed microscopic characteristics in this type specimen fit those describing *Gymnopus* and therefore a new combination is proposed. Pleurocystidia also have been seen in basidiomata of neotropical *Collybia omphalodes* (Berk.) Dennis (Dennis, 1951; Pegler, 1983, Singer, 1973) and in temperate *G. peronatus* (Bolt.: Fr.) Antonín et al. (Antonín and Noordeloos, 1997) and *G. subnudus* (Ellis ex Pk.) Halling (Murphy, 1997).

COLLYBIA NEOTROPICA Singer, Sydowia 15: 54. 1961(1962)
Holotype: BOLIVIA. La Paz, Nor Yungas, Coroico, 15.II.1956, coll. R. Singer B 1173 (LIL) [!].

Basidiome incomplete, only a small piece of pileus, including eight lamellae. **Pileus** surface glabrous, wrinkled, translucent, crenate, brown (6E/F8); margin curved, crenate, ± undulating; context tan (5B5). **Lamellae** apparently adnexed, subdistant, up to 2 mm broad; margin smooth.

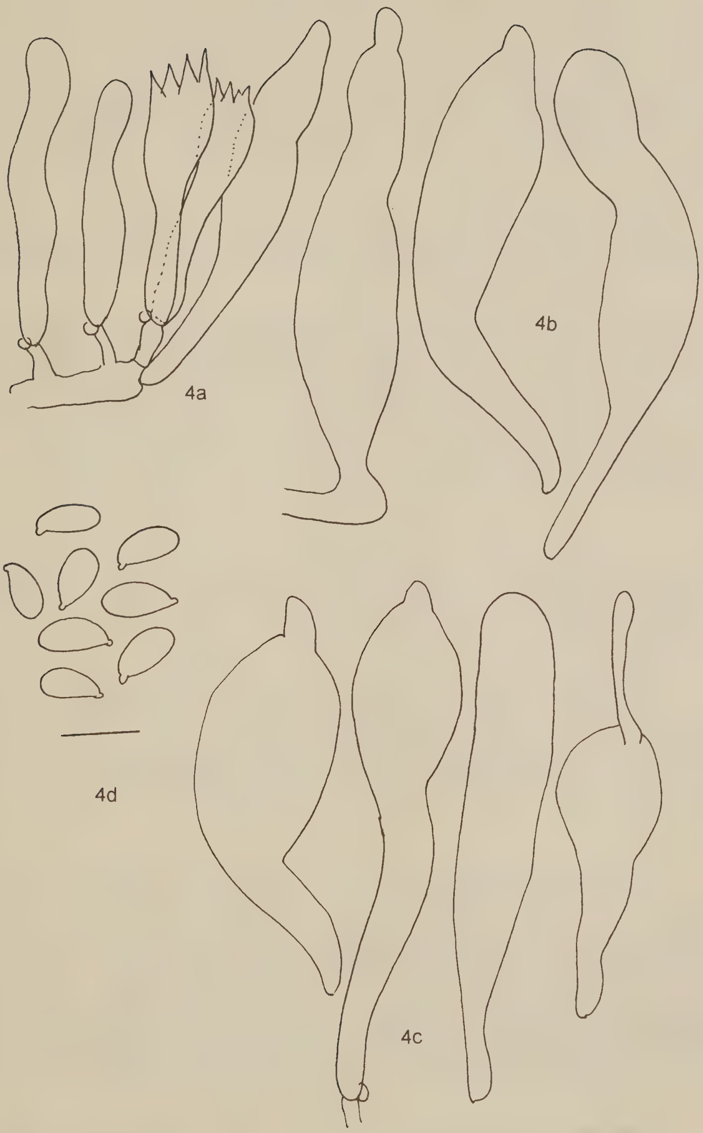


Fig. 4. Micromorphology of *Collybia lodgeae*. a. basidia, basidioles, and pleurocystidium; b. pleurocystidia; c. cheilocystidia; d. spores. Scale bar = 10 µm.

Pileus epicutis a simple cutis; hyphae 2-5 µm diam, cylindrical, repent, radially arranged, yellow-brown in mass, hyaline singly; wall thin. **Pileus trama** interwoven; hyphae 4-16 µm diam, hyaline; wall thin. **Lamellar trama** regular to subregular; hyphae 2-12 µm, hyaline; wall thin. **Basidia** (Fig. 5a) 28-32 X 5-8 µm, clavate; sterigmata four; basidioles 22-28 X 5-8 µm, clavate. **Pleurocystidia** absent. **Cheilocystidia** (Fig. 5b) 22-32 X 4-5 µm, narrowly clavate to filamentous, sometimes irregular, sometimes broader at base or at apex; apex obtuse, submucronate or barely lobed; scattered, inconspicuous. All tissues inamyloid and with clamp connections present.

Basidiospores (Fig. 5c) 7.2-9.6 X 4-5.6 µm (n = 24, x = 8.1 X 4.6 µm, Q = 1.50-2.00, Qx = 1.77), broadly lacrymoid and ellipsoid in side view, broadly ellipsoid in profile, hyaline, inamyloid; wall, smooth, thin.

Commentary: *Collybia neotropica* demands epitypification because the type specimen is not only in poor condition but almost extirpated. Dimensions and shape of basidia, basidioles, cheilocystidia and spores match those furnished by Singer (1961) in his Latin protologue. Diverticula on the hyphae of the pileus epicutis could not be observed because of the bad state of preservation of the specimen. The study of this type specimen agrees with current morphological concepts in *Gymnopus* sect. *Vestipedes,* and a new combination is proposed.

GYMNOPUS OCULATUS Murrill, N. Amer. Fl. 9: 370. 1915.
Holotype: JAMAICA. Troy and Tyre, Cockpit Co., 610 m (2000 ft), 12-14.I.1909, coll. W.A. Murrill and W. Harris no. 1022 (NY) [!].
≡ *Collybia oculata* (Murr.) Murrill, Mycologia 8: 219. 1916.

Basidiomata 10, some broken, in fair condition. **Pileus** 6-20 mm diam, convex, with age somewhat umbonate; surface yellow-brown to light orange (5B5-6C5); margin incurved, sometimes undulating. **Lamellae** adnexed, close, orange-brown (6C8); margin even; lamellulae in two tiers of different lengths. **Stipe** 25-30 X 1-2 mm, central, equal, ± terete, sometimes twisted; surface fibrillose to sulcate, ± pubescent, tan to light brown.

Pileus epicutis a cutis; hyphae 2-6 µm diam, radially oriented, cylindrical, pale brown in mass; wall thin. **Pileus trama** interwoven; hyphae 4-14 µm diam, hyaline; wall thin. **Lamellar trama** regular; hyphae 3-10 µm diam, hyaline; wall thin. **Basidia** (Fig. 6a) 14-16 X 4-5 µm, clavate; sterigmata four; basidioles 10-16 X 3-4 µm, clavate to mucronate. **Pleurocystidia** absent. **Cheilocystidia** (Fig. 6b) 20-44 X 5-8 µm, cylindrical, often lobed and diverticulate towards apex; not readily evident. **Stipe epicutis** parallel; hyphae 3-12 µm diam, cylindrical, yellowish in mass, hyaline singly; wall thin. **Caulocystidia** common, up to 50 X 12 µm, clavate to ventricose, sometimes in fascicles. All tissues inamyloid and with camp connections present.

Basidiospores (Fig. 6c) 4.8-7.2 X 2.4-4.0 µm (n = 20, x = 6.1 X 3.2µm, Q = 1.63-2.38, Qx = 1.90), ellipsoid to lacrymoid in side view, ellipsoid in profile, hyaline, inamyloid; wall smooth, thin.

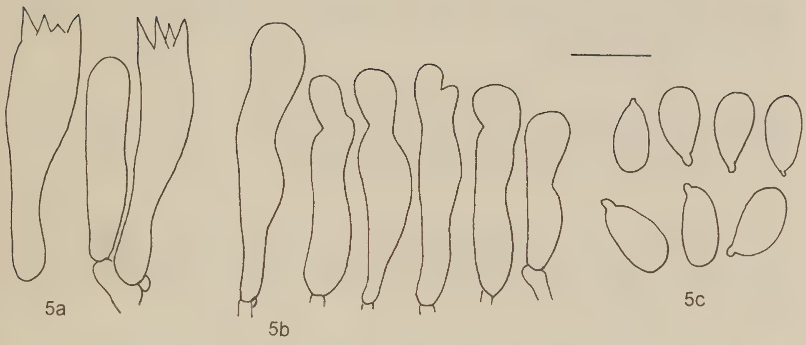


Fig. 5. Micromorphology of *Collybia neotropica*. a. basidia and basidiole; b. cheilocystidia; c. spores. Scale bar = 10 µm.

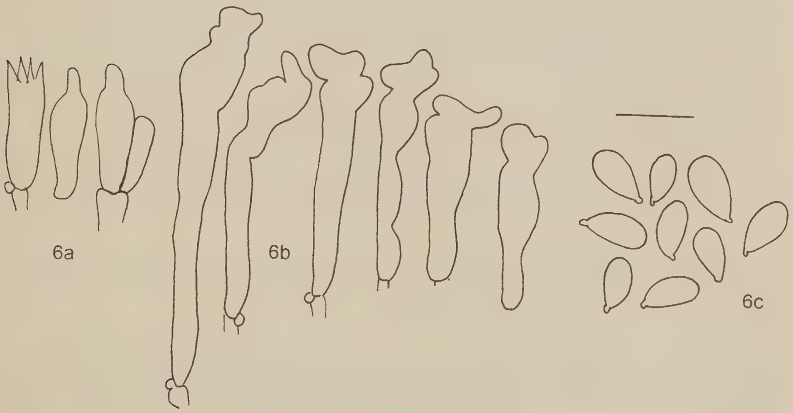


Fig. 6. Micromorphology of *Gymnopus oculatus*. a. basidium and basidioles; b. cheilocystidia; c. spores. Scale bar = 10 µm.

Commentary: In modern generic concept this species epithet is correctly combined under *Gymnopus*. This specimen was collected on decaying wood, as was the type specimen of *G. fibrosipes*. Dennis (1951) placed *G. oculatus* under synonymy with *C. fibrosipes*, and although dimensions of spores and cheilocystidia are similar, characteristics of the pileus, as described by the species' authors, are harder to match. Because of the radially arranged hyphae of the pileus epicutis, and pruinose stipe, *G. oculatus* is placed in sect. *Vestipedes*.

MARASMIUS POLYGRAMMUS Montagne, Ann. Sci. Nat. Bot. Sér. 4, 1: 118. 1854.
Holotype: GUYANA. Cayenne, Leprieur 1039 (K) [!].
≡ *Collybia polygramma* (Mont.) Dennis, Trans. Brit. Mycol. Soc. 34: 447. 1951.

Basidiome one, flat-pressed, glued to cardboard; condition of preservation poor. **Pileus** 25 mm diam, apparently depressed, brown-orange (near 6E7); surface translucent. **Lamellae** adnexed, close to subdistant, narrow, concolorous to pileus; margin smooth. **Stipe** 50 X 2 mm, terete, equal, fibrillose-scaly, with fine pruinose-vesture, dark brown to black.

Pileus epicutis a cutis; hyphae 2-6 µm diam, cylindrical, hyaline, yellow-orange in IKI; wall thin. **Pileus trama** interwoven; hyphae 4-12 µm diam, hyaline, pale orange in IKI; wall thin. **Lamellar trama** irregular; hyphae 2-6 µm diam, hyaline, yellow-orange in IKI; wall thin. **Basidia** (Fig. 7a) 22-24 X 7-9 µm diam, clavate; sterigmata four; basidioles 20-22 X 7-8 µm, clavate to subfusoid. **Pleurocystidia** not observed. Lamellar margin contaminated with molds, eroded due to preservation. **Cheilocystidia** not observed. **Stipe epicutis** parallel; hyphae 2-14 µm diam, cylindrical to inflated, pale brown in mass, hyaline singly, inamyloid; wall up to 3 µm thick. **Caulocystidia** entangled, forming a dense mat, cylindrical to clavate; hard to detect from contaminants. Clamp connections present in all tissues.

Basidiospores (Fig. 7b) 6.0-8.8 X 3.2-4.8 µm (n = 14, x = 7.8 X 4.1 µm, Q = 1.50-2.38, Qx = 1.93), lacrymoid, ellipsoid to broadly ellipsoid in side view, ellipsoid in profile, hyaline, inamyloid; wall smooth, thin.

Commentary: Examination of the type specimen of *M. polygrammus* revealed a simple cutis composed of radially-arranged cylindrical hyphae and inamyloid ellipsoid spores suggesting a combination of the epithet under *Gymnopus*. Lamellae seem to be less distantly spaced, and the pileus seems less translucent, than those of its proposed synonym, *H. hondurensis* (Dennis, 1951), but dimension of spores and basidia, together with lignicolous habit are quite similar.

MARASMIUS SUBCYATHIFORMIS Murrill, N. Amer. Fl. 9: 269. 1915.
Holotype: MEXICO, Colima, 3-4.I.1910, coll. Edna & WA Murrill no. 615 (NY) [!].
≡ *Collybia subcyathiformis* (Murr.) Pegler, Kew Bull. Add. ser. 6: 139. 1977.
≡ *Gymnopus subcyathiformis* (Murr.) Desjardin, Halling & Hemmes, Mycologia 91: 175. 1999.

Basidiomata two, moldy, in poor condition. **Pileus** 15 mm diam, convexo-depressed; surface pruinose to glabrous, brown; margin concolorous, strongly inflexed.

Lamellae adnate, narrow, subdistant; margin entire. **Stipe** 40 X 1.5 mm, equal, twisted; surface densely pruinose, brown; pruina cream.

Pileus epicutis a cutis; hyphae 3-8 µm diam, radially oriented, filamentous, not diverticulate, heavily pigment-incrusted, banded, brown in mass; wall thin. **Pileus trama** subregular; hyphae up to 12 µm diam, hyaline; wall thin. **Lamellar trama** not studied. **Basidia** (Fig. 8a) 24-26 X 7-8 µm, clavate; sterigmata four; basidioles 20-22 X 6-7 µm, clavate to mucronate. **Pleurocystidia** absent. **Cheilocystidia** (Fig. 8b) 22-36 X 5-10 µm, clavate to broadly clavate, or sphaeropedunculate, often knobbed; collapsed. **Stipe epicutis** parallel; hyphae 4-8 µm diam, cylindrical, pale brown to yellowish in mass, hyaline singly; wall thin. **Caulocystidia** abundant, 2-6 µm diam, mostly cylindrical, some ± strangulate, forming a dense mat. All tissues inamyloid and with clamp connections present.

Basidiospores (Fig. 8c) 6.8-9.2 X 3.6-4.4 µm (n = 20, x = 7.8 X 4.0 µm, Q = 170-2.20, Qx = 1.95), ellipsoid to lacrymoid in side view, ellipsoid in profile, hyaline, inamyloid; wall smooth, thin.

Commentary: According to Desjardin et al. (1999) no abundant cystidia could be observed in *M. subcyathiformis*. Macroscopically, basidiomata of *M. subcyathiformis* are similar to those of *G. menehune* and *G. collybioides* (Desjardin et al., 1999), and to those of North American *G. biformis* in stature and shape, ecology, and microscopic elements such as basidiospores and cheilocystidia (Mata, 2002).

NEW COMBINATIONS

Gymnopus fibrosipes (Berk. & M. A. Curtis) J.L. Mata, *comb. nov.*
Basionym: *Marasmius fibrosipes* Berkeley and Curtis. J. Linn. Soc. (Bot.). 10: 293. 1868.

Gymnopus hondurensis (Murrill) J.L. Mata, *comb. nov.*
Basionym: *Heliomyces hondurensis* Murrill. N. Amer. Fl. 9: 248. 1915.

Gymnopus lodgeae (Singer) J.L. Mata, *comb. nov.*
Basionym: *Collybia lodgeae* Singer, Fieldiana, Botany n.s. 21: 23. 1989.

Gymnopus neotropicus (Singer) J.L. Mata, *comb. nov.*
Basionym: *Collybia neotropica* Singer. Sydowia 15: 54. 1961(1962).

Gymnopus polygrammus (Mont.) J.L. Mata, *comb. nov.*
Basionym: *Marasmius polygrammus* Montagne. Ann. Sci. Nat. Bot. Sér. 4, 1: 118. 1854.

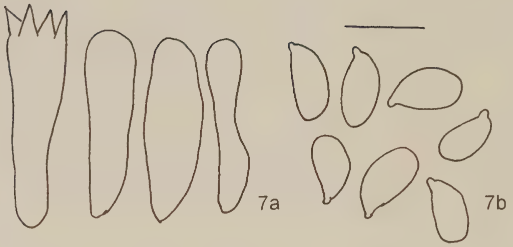


Fig. 7. Micromorphology of *Marasmius polygrammus*. a. basidium and basidioles; b. spores. Scale bar = 10 µm.

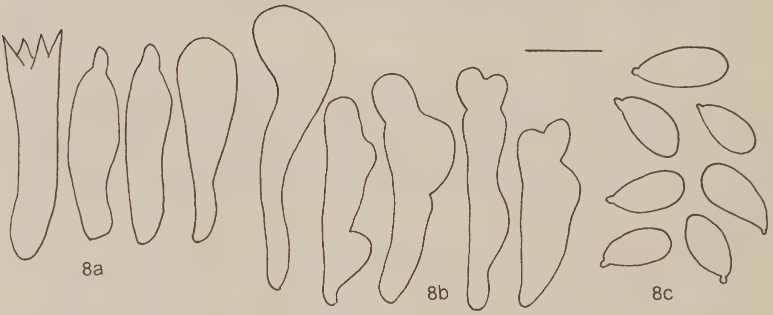


Fig. 8. Micromorphology of *Marasmius subcyathiformis*. a. basidium and basidioles; b. cheilocystidia; c. spores. Scale bar = 10 µm.

ACKNOWLEDGEMENTS

The following herbaria loaned type specimens needed for this paper: The New York Botanical Garden, Field Museum of Natural History in Chicago; Herbarium at San Miguel de Tucumán and Instituto Spegazzini in La Plata, Argentina; Royal Botanic Gardens, Kew, England. The entirety of this project was possible thanks to the financial support of NSF-Partnership for Enhancing Expertise in Taxonomy (PEET) Grants DEB 9521526 and DEB 9978011. We thank Dr. Clark Ovrebo for reviewing this manuscript.

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THE GENUS AGROCYBE IN KERALA STATE, INDIA

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Abstract: Six species of *Agrocybe* from Kerala State, India are considered. Four new species, *Agrocybe munnarensis, A. calicutensis, A. wayanadensis,* and *A. guruvayoorensis* are described. *Agrocybe temulenta* is a new record for India. *Agrocybe pediades* is described from a new locality.

Keywords: Basidiomycota, Agaricales, Bolbitiaceae, new species, new records

INTRODUCTION

Watling & Abraham (1986) gave a summary of the state of knowledge of the genus *Agrocybe* (Basidiomycota, Agaricales, Bolbitiaceae) in the Indian subcontinent. About seventeen species have been recorded to this date of which only *A. manihotis* Pegler (Natarajan & Raman, 1983) and *A. pediades* (Fr.) Fayod (Abraham & Nair, 1987) are previously known from Kerala State. In this paper, we describe the species of *Agrocybe* collected by us from Kerala. It completes an earlier account (Thomas, Hausknecht & Manimohan, 2001) on Bolbitiaceae of this region.

MATERIALS AND METHODS

Microscopic observations were made on material mounted in 3% aqueous KOH. Colour codes refer to Kornerup & Wanscher (1978). Spore statistics are based on measurement of twenty spores. All collections examined are deposited in the National Herbarium of the Netherlands, Leiden (L.).

KEY TO THE SPECIES

1. Basidiomata with a distinct annulus.. 5
1. Basidiomata without an annulus.. 2
2. Pileus surface subviscid; cheilocystidia usually ventricose-fusoid, lageniform or almost tibiiform 3
2. Pileus surface not viscid; cheilocystidia mostly clavate or vesiculose 4
3. Pileus pale- or light orange sometimes with white powdery velar remnants towards margin; spores 9–14.5 µm long; basidia 4-spored ....
....***Agrocybe pediades***

3. Pileus brown, without velar remnants; spores 11–19 µm long; basidia mostly 2-spored.. ***Agrocybe temulenta***
4. Basidiomata on decaying grass tufts; pileus translucently striate when moist; spores 9–12.5 µm long .... ***Agrocybe* munnarensis**
4. Basidiomata on soil; pileus not striate when moist; spores 12–18 µm long .... ***Agrocybe* calicutensis**
5. Pileus up to 200 mm diam.; basidiomata robust, on decaying logs; annulus not evanescent; basidia 2-spored; pileocystidia present .... ***Agrocybe* wayanadensis**
5. Pileus less than 60 mm diam.; basidiomata fragile, on elephant dung; annulus evanescent; basidia 4-spored; pileocystidia absent ....***Agrocybe* guruvayoorensis**

DESCRIPTION OF SPECIES

1. Agrocybe pediades (Fr.) Fayod in Ann. Sci. Nat. (Bot.) Series 7,9: 358, 1889. Figs. 1-6

Pileus 6–35 mm diam., hemispherical to convex, becoming plano-convex to plane, sometimes with an indistinct umbo or a small depression at the disc; surface pale orange (5A3) or light orange (5A4) at the centre, orange white (5A2) towards margin, glabrous, sometimes with white powdery velar remnants towards margin especially when young, non-hygrophanous, dull, slightly sticky when moist; margin initially incurved, becoming decurved and finally plane, initially entire, at times becoming fissile. Context up to 3 mm thick at centre, whitish or orange white (5A2). Lamellae adnate to adnato-adnexed, light brown (6D4) to greyish brown (7D3), crowded to subcrowded, with lamellulae of 3 lengths, up to 8 mm wide; edge pale, finely scalloped. Stipe 25–60 x 1.5–4 mm, central, terete, almost equal or broader towards both ends with a bulbous base, solid, turning to fistulose; surface pale orange (5A3) or orange white (5A2), initially coated with velar remnants, later glabrescent, without an annulus; base with a few rhizoids. Odour not distinctive. Spore-print dark brown (6F8).

Spores 9–14.5 x 7–9 x 6.5–8 (12.28±1.49 x 7.97±0.62 x 7.03±0.45) µm, Q =1.27–1.68, Qm =1.52, lenticular, ovoid in face-view, ellipsoid in side-view, cinnamon brown, smooth, thick-walled, apically truncated by a germ-pore up to 1µm wide. Basidia 24–39 x 8.5–12.5 µm, cylindrico-clavate, frequently with a slight medium constriction, 4-spored; sterigmata up to 6 µm long. Lamella-edge sterile to heteromorphous. Cheilocystidia 13–34.5 x 5–10.5 µm, lageniform or rarely somewhat tibiiform, sometimes distal end capped with a resinous substance, thin-walled, hyaline. Pleurocystidia none. Hymenophoral trama regular; hyphae 2–19 µm wide, thin-walled, hyaline. Pileal trama loosely interwoven; hyphae 2–17.5 µm wide, thin-walled, hyaline to yellowish. Pileipellis hymeniform, sometimes covered with a poorly developed gelatinous

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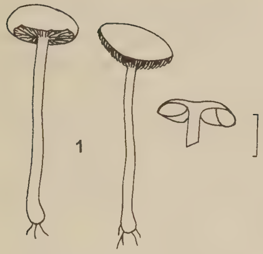
Figs. 1-6, *Agrocybe pediades*: 1, basidiomata; 2, spores; 3, basidia; 4, cheilocystidia; 5, elements of pileipellis; 6, caulocystidia; scale bar = 10 mm for basidiomata and 10 µm for microstructures.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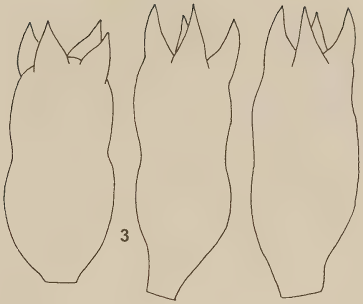
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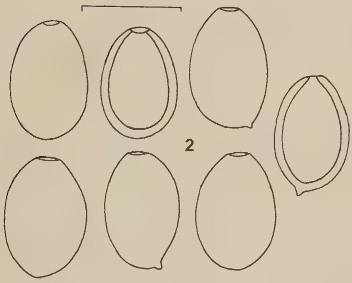
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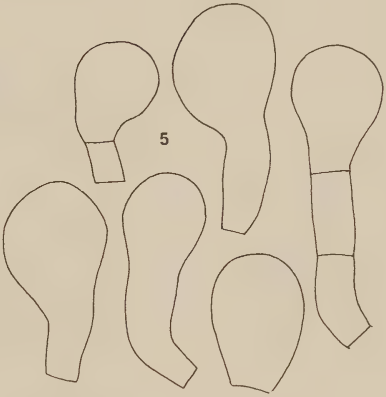
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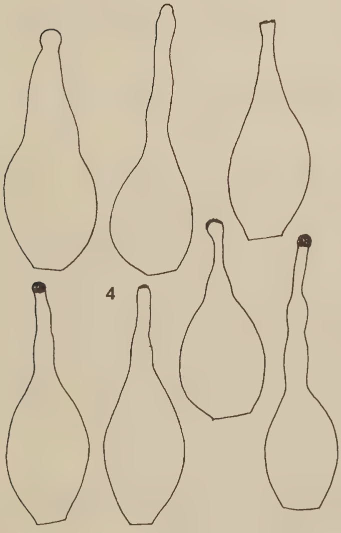
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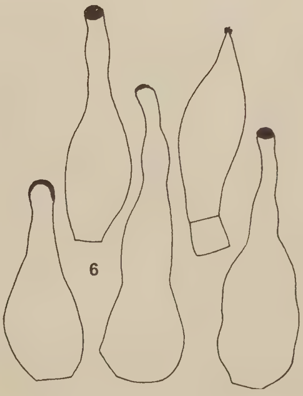
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layer; elements 8–35.5 x 6–13 µm, pedicellate-clavate, disrupted in most specimens, thin-walled, hyaline towards distal end, yellowish towards base. Hypodermium composed of 2–7 µm wide, thin walled hyphae with light yellowish brown encrustation. Stipe trama composed of 2–15.5 µm wide hyphae, thin-walled, hyaline or with a pale yellow wall pigment. Stipitipellis a cutis; hyphae 1.5–5 µm wide, thin to slightly thick-walled, yellowish to light yellowish brown. Caulocystidia 15–40 x 5–10 µm, narrowly lageniform to almost tibiiform, apex capped with a resinous substance, thin-walled, hyaline, restricted to upper part of the stipe. Clamp-connexions present.

On sandy roadside, sometimes attached to grass roots and other plant debris, gregarious to scattered, May-August.

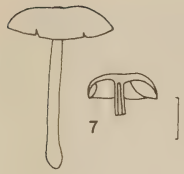
Specimens examined: India, Kerala State, Wayanad District, Ponkuzhy: 10 June 1998, K. A. Thomas T268; 16 June 1998, K. A. Thomas T268b; 30 June 1998, K. A. Thomas T268c; 16 August 1998, K. A. Thomas T268d; 11 May 1999, K. A Thomas T268e; 25 May 1999, K. A. Thomas T268f (all at L).

The Kerala collections are indistinguishable from *Agrocybe pediades* described from other parts of the world (e.g., Watling, 1982; Watling & Taylor, 1987). This species is characterized by a pale coloured, convex pileus with white powdery velar remnants towards margin when young, non-annulate stipe, large spores with truncate germ-pores, 4-spored basidia, lageniform to somewhat tibiiform cystidia and clamped hyphae. *Agrocybe semiorbicularis* (Bull.) Fayod is extremely close and it is considered synonymous to *A. pediades* by some authors (e.g. Nauta, 1986; Breitenbach & Kränzlin, 1995), but that species is predominantly bisporic, and has yellowish brown pileus and larger spores. *Agrocybe pediades* seems to prefer sandy soil as is evident from the Kerala collections, British records (Watling, 1982), and New Zealand collections (Watling & Taylor, 1987). There is an earlier record of this species from Kerala (Abraham & Nair, 1987).

2. Agrocybe temulenta (Fr.) Singer in Beih. Bot. Centralblatt, Abt. B56: 167, 1936. Figs. 7-13

Pileus 10–45 mm diam., hemispherical, becoming convex to broadly convex, sometimes with a small central depression when fully mature; surface brown (6D7), slightly fading towards margin or orange (5A6) with brown tint at the centre and light orange towards the margin, smooth, glabrous, slightly lubricous; margin incurved, becoming decurved, entire, sometimes becoming fissile. Context up to 2 mm thick at the centre, whitish or with an orange tint. Lamellae adnate, greyish orange (5B3, 5B4) when young, becoming light brown (6D5, 6D6) on maturity, subcrowded to crowded, up to 7 mm wide, with lamellulae of 3 lengths; edge pale, almost entire or eroded under a lens. Stipe 25–60 x 2–4 mm, central, terete, almost equal or sometimes with a slightly enlarged base, fistulose; surface pale orange (5A3) or light orange (5A4), faintly longitudinally striate. Odour not distinctive. Spore-print brown (6E7).

Figs, 7-13, *Agrocybe temulenta*: 7, basidioma; 8, spores; 9, basidia; 10, cheilocystidia; 11, pleurocystidia; 12, elements of pileipellis; 13, caulocystidia; scale bar = 10 mm for basidioma and 10 µm for microstructures.



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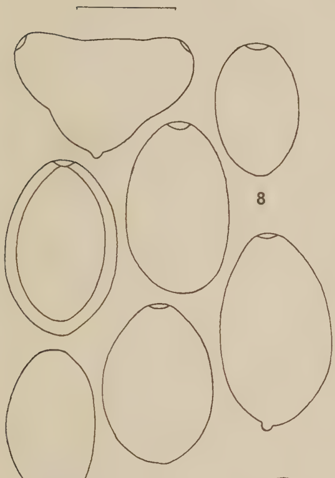

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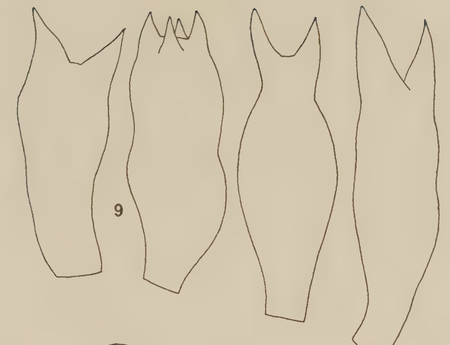

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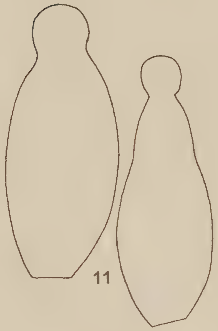

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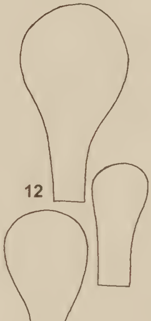

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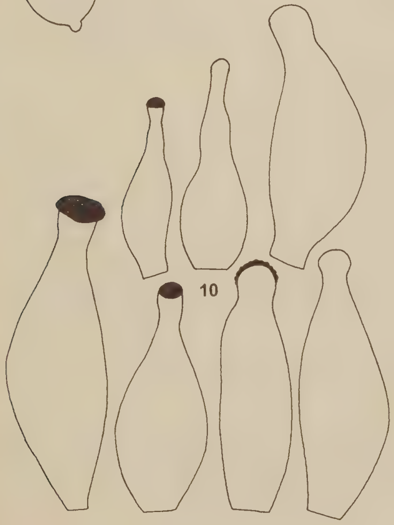

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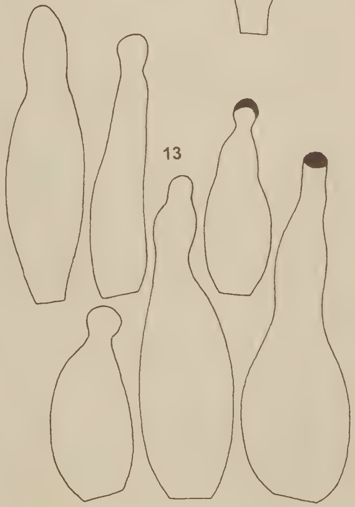

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Spores 11–19 x 7.5–12 x 7–11 (15.20±2.19 x 9.79±1.27 x 9.22±1.07) µm, Q=1.41–1.68, Qm=1.56, ovo-ellipsoid in face-view, ellipsoid in side-view, melleous brown, thick-walled, with an apical germ-pore up to 2 µm wide, rarely biporate. Basidia 24–35 x 7.5–11.5 µm, clavate, sometimes with a median constriction, mostly 2-spored, rarely 4-spored; sterigmata up to 9 µm long. Lamella-edge sterile. Cheilocystidia 16.5–44 x 5–14 µm, mostly ventricose-fusoid with a globose capitellum, rarely clavate or lageniform, occasionally with an apical resinous cap, thin-walled, hyaline. Pleurocystidia rare, similar to cheilocystidia in all aspects. Hymenophoral trama regular to subregular; hyphae 2–14 µm wide, thin-walled, hyaline to pale yellow. Pileal trama loosely interwoven; hyphae 2–15.5 µm wide, thin-walled, light yellowish brown, sometimes faintly encrusted. Pileipellis a hymeniform layer covered with a poorly developed gelatinous layer; elements 12–25 x 4.5–12 µm, inflated-clavate to vesiculose, thin-walled, pale yellow towards apex, light yellowish brown and sometimes faintly encrusted towards base, overlying a hypodermium of 2–6.5 µm wide, yellowish brown, and faintly encrusted hyphae. Stipe trama composed of 1.5–15 µm wide, thin-walled, pale yellowish hyphae. Stipitipellis a cutis; hyphae 1.5–7.5 µm wide, thin-walled, light yellowish brown, faintly encrusted. Caulocystidia similar to cheilocystidia in size and morphology, in clusters or scattered, towards the upper part of the stipe. Clamp-connexions present in all parts of the basidioma.

On sandy soil, amongst grass, gregarious to scattered, October.

Specimens examined: India, Kerala State, Idukki District, Munnar: 11 October 1999, K. A. Thomas T334; 12 October 1999, K. A. Thomas T334b (all at L).

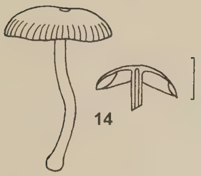
The present collections are remarkably similar to the Sri Lankan material described as *A. semiorbicularis* by Pegler (1986). The only deviation is the broader size range of the spores of the present collections. However, owing to the expanding pileus and the cystidial morphology, these collections seem to be more in accordance with *A. temulenta* sensu Watling.

3. Agrocybe munnarensis K. A. Thomas & Manim. **sp. nov**. Figs. 14-20

Pileus 12-30 mm latus, convexus vel plano-convexus, valde hygrophanus, primo griseo-aurantiacus, postea pallide luteus, glaber pellucido-striatus. Lamellae adnatae primo griseo-aurantiacae, postea brunneae, subconfertae, lamellulis intermixtae. Stipes 28-45 x 2-2.5 mm, griseo-aurantiacus, pruinosus. Sporae 9-12.5 x 6-8.5 x 5.5-7 µm, ellipsoideae, lentiformes, leaves, crassitunicatae, truncato poro germinativo praeditae. Basidia 20-29 x 7-9 µm, clavata, 4-vel 2-sporigera. Cheilocystidia 10-32.5 x 7-18 µm, clavata, raro versiformia. Pleurocystidia 29-71.5 x 9.5-21.5 µm, utriformia, raro clavata. Pileipellis hemeniformis, cellulis sphaero-pedunculatis composita. Caulocystidia 15-54 x 5.5-18 µm, versiformia. Hyphae omnes fibulatae. Ad graminum putrefactum.

Typus; India, Kerala State, Idukki District, Munnar, 11 October 1999, K. A. Thomas T331 (L, holotypus).

Figs. 14-20, *Agrocybe munnarensis*: 14, basidioma; 15, spores; 16, basidia; 17, cheilocystidia; 18, pleurocystidia; 19, caulocystidia; 20, elements of pielipellis; scale bar = 10 mm for basidioma and 10 um for microstructures.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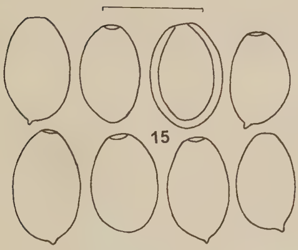
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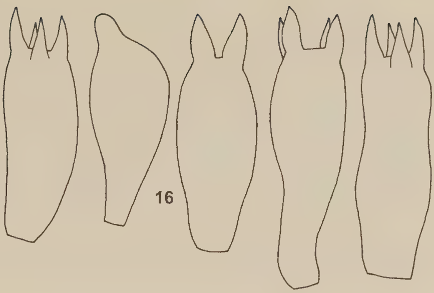
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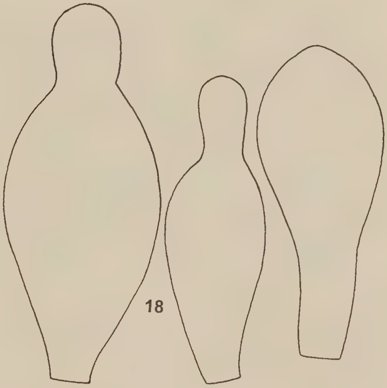
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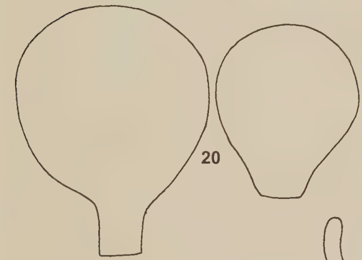
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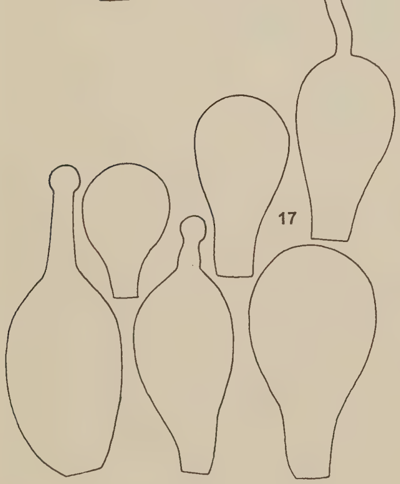
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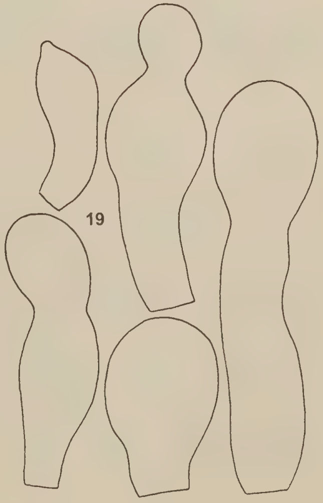
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Pileus 12–30 mm diam., convex to plano-convex, without umbo; surface greyish orange (5B3), rarely brown (6E4), strongly hygrophanous and becoming light yellow (4A4) or light orange (5A4), smooth, glabrous, translucent-striate when moist; margin decurved to almost plane, entire, sometimes becoming fissile. Context up to 1 mm thick at the centre, whitish. Lamellae adnate, becoming adnexed, initially greyish orange (5B3), later light brown (6D6), brown (6E7) or dark brown (7F7, 7F8), crowded to moderately crowded, up to 5 mm wide, with lamellulae of 3–4 lengths; edge slightly paler than sides, entire. Stipe 28–45 x 2–2.5 mm, central, terete to slightly compressed, almost equal, fistulose, becoming hollow; surface greyish orange (5B3), faintly pruinose, especially towards apex under a lens; base slightly swollen. Odour not distinctive. Spore-print brown (6E7).

Spores 9–12.5 x 6–8.5 x 5.5–7 (10.63±1.23 x 7.09±0.64 x 6.37±0.50) µm, Q=1.36–1.65, Qm=1.49, lenticular, ovo-ellipsoid to ellipsoid in face-view, ellipsoid in side-view, brown, thick-walled, truncated with an apical germ-pore up to 1µm wide. Basidia 20–29 x 7–9 µm, clavate, 4-spored, occasionally 2-spored; sterigmata up to 7.5 µm long. Lamella-edge sterile with a dense layer of cheilocystidia. Cheilocystidia 10–32.5 x 7–18 µm, mostly clavate or vesiculose rarely lageniform or lecythiform, thin-walled, hyaline. Pleurocystidia 29–71.5 x 9.5–21.5 µm, not frequent, mostly narrowly utriform, rarely clavate, containing some hyaline inclusions, thin-walled, hyaline. Hymenophoral trama regular to subregular; hyphae 2–15 µm wide, thin-walled, light yellow to light greyish brown; subhymenium conspicuous, composed of pseudoparenchymatous cells. Pileal trama interwoven; hyphae 2–15.5 µm wide, thin-walled, pale yellow to yellow. Pileipellis hymeniform, composed of pyriform, sphaeropedunculate or clavate elements of 15.5–44 x 12.5–27.5 µm, thin-walled, pale yellow. Stipe trama composed of 2–24 µm wide, thin-walled, yellowish hyphae. Caulocystidia 15–54 x 5.5–18 µm, versiform: pedicellate-clavate, cylindric-flexuous, or ventricose-fusoid, occurring towards the upper part of the stipe, in clusters, thin-walled, hyaline. Clamp-connexions present on all hyphae.

On decaying grass tufts, scattered, October.

Specimens examined: India, Kerala State, Idukki District, Munnar: 11 October 1999, K. A. Thomas T331; 12 October 1999, K. A. Thomas T331b (all at L).

This species is characterized by a thin, highly hygrophanous and pellucid-striate pileus, total absence of velar remnants, large (mostly > 10 µm) spores with truncate germ-pores, versiform cheilocystidia, utriform pleurocystidia, and versiform caulocystidia. It seems to belong to the section *Microsporae* (Fr.) Singer. Microscopically it is very similar to *Agrocybe earlei* (Murrill) Watling, but that species is not hygrophanous and not pellucid-striate and it grows on humus. *Agrocybe cubensis* (Murrill) Singer has similar spores and habitat but it has a chestnut brown pileus with floccose velar remnants and lacks pleurocystidia. *Agrocybe sororia* (Peck) Watling is similar in many characters including the spore-size, but that species has different cystidia and a subviscid pileus.

4. Agrocybe calicutensis K. A. Thomas & Manim. **sp. nov.** Figs. 21-27

Pileus 10-30 mm latus, convexus vel applanatus, raro umbonatus, pallide luteus, glaber. Lamellae adnatae vel adnexae, pallide luteae, subconfertae, lamellulis intermixtae. Stipes 20-55 x 2-6 mm, pallide luteus, glaber. Sporae 12-18 x 8-11.5 x 7.5-9.5 µm, ovo-ellipsoideae, lentiformes, luteo-brunneae, leaves, crassitunicatae, truncato poro germinativo praeditae. Basidia 24-45 x 10-15.5 µm, clavata vel pedicellato-clavata, 4-sporigera. Cheilocystidia 16-65 x 7-27.5 µm, versiformia. Pleurocystidia rarissima, cheilocystidiis similia. Pileipellis hymeniformis, cellulis subglobosis vel pyriformibus composita. Caulocystidia 12.5-70 x 7.5-24 µm, cheilocystidiis similia. Hyphae omnes fibulatae. Ad terrum.

Typus: India, Kerala State, Malappuram District, Calicut University Campus, 7 June 1998, K. A. Thomas T255 (L, holotypus).

Pileus 10–30 mm diam., convex becoming applanate with or without a broad umbo; surface light yellow (4A4) to pale orange (5A3) at the centre, yellowish white (4A2) or pale yellow (4A3) towards margin, irregularly pitted at periphery, glabrous; margin decurved to plane, finally slightly upturned, almost entire, becoming crenate to eroded or fissile. Context up to 4 mm thick at the centre, yellowish white (4A2). Lamellae narrowly adnate to adnexed, pale yellow (4A3) to pale orange (5A3), subcrowded to crowded, up to 4 mm wide, with lamellulae of 3-4 lengths; edge pale, finely pruinose under a lens. Stipe 20–55 x 2–6 mm, central, terete, tapering towards apex, solid, turning to fistulose; surface pale yellow (4A3) to orange white (5A2), glabrous; base slightly swollen, sometimes with a few rhizoids attached. Odour not distinctive. Spore-print not obtained.

Spores 12–18 x 8–11.5 x 7.5–9.5 (14.58±1.52 x 9.20±1.08 x 8.08±0.67) µm, Q=1.43–1.77, Qm=1.58, lenticular, ovo-ellipsoid, yellowish brown, smooth, thick-walled, apically truncated by a germ-pore up to 1.5 µm wide. Basidia 24–45 x 10–15.5 µm, clavate or pedicellate-clavate, 4-spored; sterigmata up to 7.5 µm long. Lamella-edge sterile to heteromorphous. Cheilocystidia 16–65 x 7–27.5 µm, versiform: pedicellate-clavate, sphaeropedunculate, ventricose-fusoid, utriform, or flexuous, thin-walled, hyaline. Pleurocystidia occasionally present in some collections, similar to cheilocystidia in size and shape, rarely with small apical resinous encrustations. Hymenophoral trama regular; hyphae 2–11.5 µm wide, thin-walled, hyaline. Pileal trama interwoven; hyphae 2-16.5 µm wide, long, filamentous, thin-walled, hyaline. Pileipellis hymeniform; cells 15–49 x 12.5–29 µm, subspherical to pyriform, sometimes sphaeropedunculate, thin-walled, hyaline, pale yellowish towards base. Stipe trama composed of 1.5–17.5 µm wide hyphae, thin-walled, hyaline. Stipitipellis a repent cutis, hyphae 2–7 µm wide, thin-walled, hyaline to pale yellow. Caulocystidia 12.5–70 x 7.5–24 µm, similar to cheilo- and pleurocystidia in morphology, distal ends rarely encrusted with resinous material, occurring towards the upper part of the stipe, in groups or scattered. Clamp-connexions present in all hyphae.

On the ground, frequently near *Casuarina* trees, scattered, May-June.

Specimens examined: India, Kerala State, Malappuram District, Calicut University Campus: 7 June 1998, K. A. Thomas T255; 11 June 1998, K. A. Thomas T255b; 8 June 1998, K. A. Thomas T257; 9 June 1998, K. A. Thomas T257b; 10 June 1988, K. A. Thomas T257c; 12 May 1999, K. A. Thomas T257d (all at L).

This species has the following diagnostic features: (1) yellow colour to all parts of the basidiomata; (2) total absence of velar remnants; (3) broad size-range (12–18 μm long) and truncate germ-pore of the spores; (4) 4-spored basidia; (5) versiform cheilocystidia; (6) occasional presence of pleurocystidia; and (7) caulocystidia restricted to the upper part of the stipe. It belongs to the section *Pediadeae* of subgenus *Agrocybe* where it seems to be close to several species such as *A. broadwayii* (Murrill) Dennis, *A. semiorbicularis* (Bull.) Fayod, and *A. malesiana* Watling. The Kerala collections, however, represent an as yet undescribed species owing to the combination of features outlined above. *Agrocybe broadwayii* has a viscid pileus and narrower spores and it lacks pleurocystidia. *Agrocybe semiorbicularis* has a viscid pileus, 2-spored basidia, and smaller spores. *Agrocybe malesiana* appears to be the closest differing in the conico-companulate, clay-coloured pileus with appendiculate margin showing cortinoid veil.

5. Agrocybe wayanadensis K. A. Thomas & Manim. **sp. nov.**

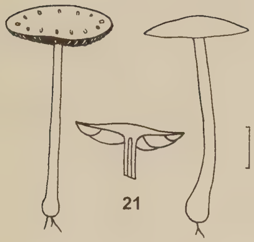
Figs. 28-34

Basidiocarpus robustus. Pileus 40-200 mm latus, convexus vel applanatus, ad *discum* depressus, pallide aurantiacus, glaber. Lamellae adnatae, griseo-aurantiacae vel pallide brunneae, subconfertae, lamellulis intermixtae. Stipes 40-110 x 3.5-20 mm, solidus, pallide aurantiacus, fibrilloso-striatus, annulatus. Annulus persistens, superus, striatus. Sporae 9-16.5 x 5.5-8 μm, ellipsoideae, oblongo-ellipsoideae, subreniformiae vel cylindricae, raro constrictae, leaves, crassitunicatae, luteo-brunneae. Basidia 24-39 x 6-9 μm, cylindrica, raro constricta, 2-sporigera. Cheilocystidia 12.5-60 x 6.5-12.5 μm, versiformia. Pleurocystidia 32.5-57.5 x 9-14.5 μm, clavato-mucronata. Pileipellis hymeniformis. Pileocystidia 15-49 x 8-17.5 μm, cheilocystidiis similia. Caulocystidia 15-77.5 x 5 – 15 μm, cheilocystidiis similia. Hyphae omnes fibulatae, Ad lignum putrefactum.

Typus: India, Kerala State, Wayanad District, Muthanga Forest, 25 June 1997, K. A. Thomas T 87 (L, holotypus).

Basidiomata robust, medium-sized to very large. Pileus 40–200 mm diam., convex to applanate, frequently becoming depressed at the centre; surface light orange (5A3), pale orange (5A4) or greyish orange (5B3) at the centre, fading towards margin to orange white (5A2), not striate, moist, glabrous, smooth or sometimes irregularly pitted; margin incurved when young, turning to plane and finally becoming slightly upturned, almost entire to slightly eroded. Context fleshy, whitish, up to 18 mm thick at the centre. Lamellae adnate to slightly adnexed, greyish orange (5B3), orange grey (5B2) or light brown (6D5), subcrowded, up to 12 mm wide, with lamellulae of 3 lengths; edge pale, almost entire, serrate or slightly eroded under a lens. Stipe 40–110 x 3.5–20 mm, central, terete, almost equal or broad at the base, solid, with a well-developed, persistent, striate, superior annulus. Surface pale orange (5A3) to orange white (5A2); fibrillose-striate; base deeply immersed in the woody substratum. A colourless liquid oozing out from fresh stipes when wounded. Odour not distinctive. Spore-print brown (6E7).

Figs. 21-27, *Agrocybe calicutensis*: 21, basidiomata; 22, spores; 23, basidia; 24, cheilocystidia; 25, pleurocystidia; 26, elements of pielipellis; 27, caulocystidia; scale bar = 10 mm for basidiomata and 10 μm for microstructures.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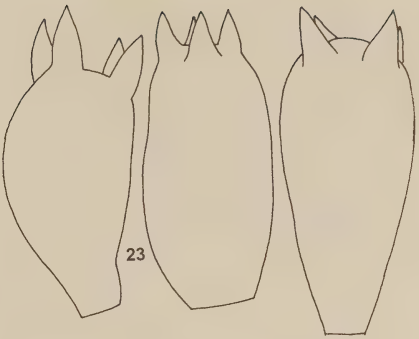
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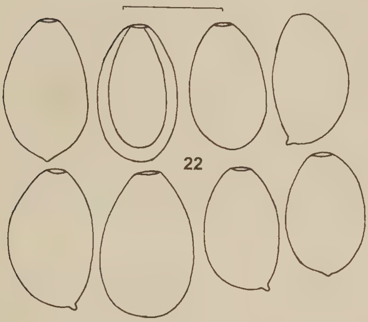
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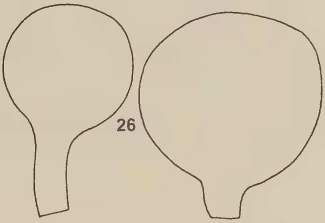
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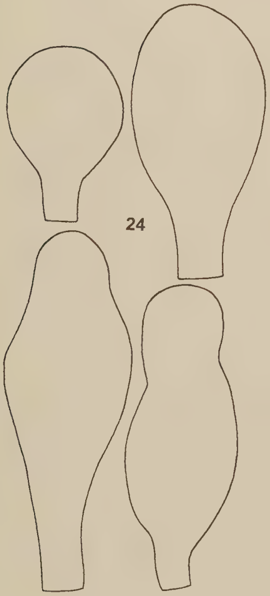
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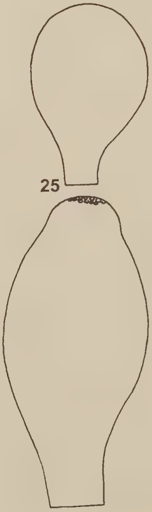
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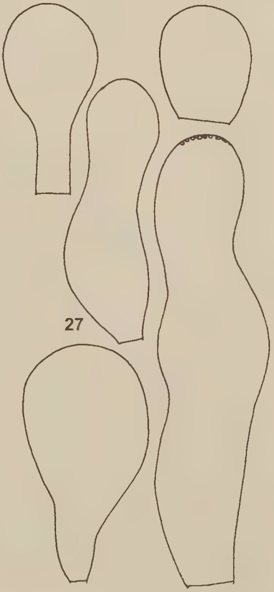
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Spores 9–16.5 x 5.5–8 (12.23±2.04 x 6.55±0.76) μm, Q=1.47–2.17, Qm=1.85, ellipsoid, ellipsoid-oblong, subreniform or somewhat cylindric, occasionally with a constriction, smooth, with a thickened yellowish brown wall and an apical germ-pore up to 1.5 μm wide. Basidia 24-39 x 6-9 μm, cylindric, sometimes with a median constriction, 2-spored (rarely 1-spored); sterigmata up to 7 μm long. Lamella-edge sterile. Cheilocystidia 12.5–60 x 6.5–12.5 μm, versiform: clavate, fusoid cylindric or utriform, sometimes mucronate or with a subcapitate apex, crowded, hyaline to pale yellowish brown pigmented wall. Pleurocystidia 32.5–57.5 x 9–14.5 μm, clavate-mucronate, scattered, thin-walled, hyaline. Hymenophoral trama regular; hyphae 2.5-20 μm wide, thin-walled, hyaline to pale yellowish brown. Pileal trama loosely interwoven; hyphae 2–19 μm wide, thin-walled, hyaline to pale yellowish brown. Pileipellis hymeniform; elements 17.5–47 x 12.5–35 μm, difficult to separate, hyaline to pale yellowish brown. Pileocystidia 15–49 x 8–17.5 μm, similar to cheilocystidia in shape, scattered, hyaline. Stipe trama composed of 25–30 μm wide, parallel, thin- to slightly thick-walled hyphae with a yellowish brown wall. Stipitipellis a cutis; hyphae 2–12 μm wide, thin to slightly thick-walled, with a yellowish brown wall, faintly encrusted. Caulocystidia 15–77.5 x 5–15 μm, similar to cheilocystidia in shape, thin-walled, hyaline to yellowish brown. All hyphae with clamp-connexions.

On decaying logs, scattered or in caespitose groups, June-October.

Specimens examined: India, Kerala State, Wayanad District, Muthanga Forest: 25 June 1997, K. A. Thomas T87; 26 October 1998, K. A. Thomas T87b; 27 October 1998, K. A. Thomas T87c (all at L).

This species is characterized by (1) medium to very large, pale coloured basidiomata growing in clusters on decaying wood; (2) stipe with a well-developed superior annulus; (3) exudation of a colourless liquid when stipe is cut; (4) large spores with an indistinct germ pore; (5) exclusively 2-spored basidia; (6) versiform cheilocystidia and clavato-mucronate pleurocystidia; (7) presence of both pileocystidia and caulocystidia; and (8) presence of clamp connexions in all parts of the basidiomata. The large, fleshy, pale coloured, lignicolous basidiomata with annulate stipe and the spores with small, indistinct germ-pores suggest that it belongs in section *Aporus* (Singer) Singer of the subgenus *Aporus* Singer where it is reminiscent of *Agrocybe cylindrica* (DC: Fr.) Maire in most of the macroscopic features. This species, however, is distinct from *A. cylindrica* in several microscopic characters. The spores of the present collections are distinctly larger and the basidia are constantly bisporic. The cheilo- and pleurocystidia are of the same shape in *A. cylindrica* whereas in the present collections, the constantly clavato-mucronate pleurocystidia are distinctly different from the cheilocystidia. Size and shape of the basidiomata and spore size of our collections are strikingly similar to those of the Sri Lankan species *A. badia* (Petch) Pegler, but again, the constantly bisporic basidia,

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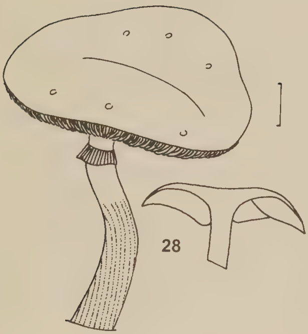
Figs. 28-34, *Agrocybe wayanadensis*: 28, basidiomata; 29, spores; 30, basidia; 31, cheilocystidia; 32, pleurocystidia; 33, pileocystidia; 34, caulocystidia; scale bar = 10 mm for basiomata and 10 μm for microstructures.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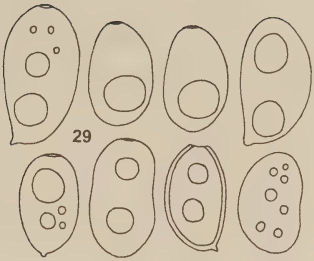
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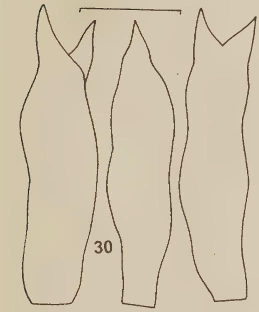
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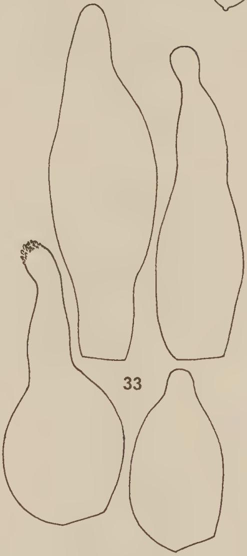
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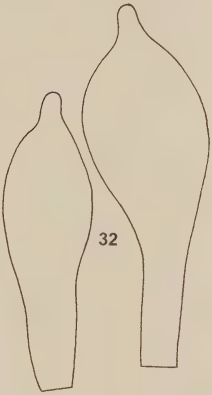
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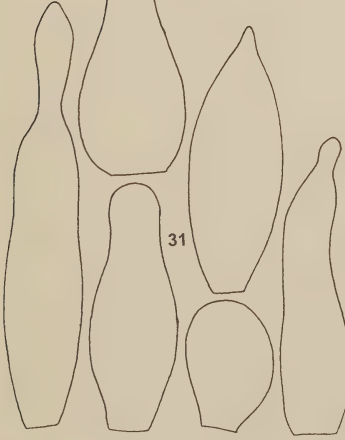
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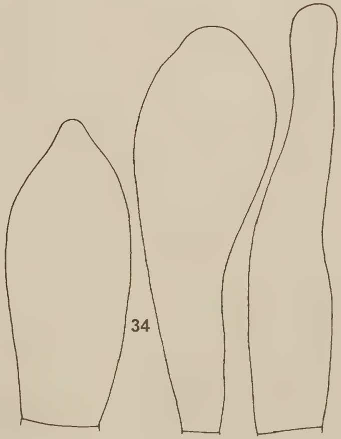
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the constantly clavate-mucronate pleurocystidia and the presence of pileocystidia make our collections quite distinct.

6. Agrocybe guruvayoorensis K. A. Thomas & Manim. **sp. nov.**

Figs. 35-41

Basidiocarpus fragilis. Pileus 15-60 mm latus, convexus vel applanatus, pallide luteus, glaber, ad marginem leviter pellucido-striatus. Lamellae adnexae, brunneae, subconfertae, lamellulis intermixtae. Stipes 30-140 x 2-8 mm, cavus, luteo-albus, ad apicem pruinosus, annulatus. Annulus centralis, evanidus. Sporae 9-13.5 x 6.5-9 x 6-8 μm, ovo-ellipsoideae vel ellipsoideae, lentiformes, melleo-brunneae, leaves, crassitunicatae, truncato poro germinativo praeditae. Basidia 22-28 x 8.5-12 μm, clavata, 4-sporigera. Cheilocystidia 11.5-60 x 9-27.5 μm, versiformia. Pleurocystidia rarissima, cheilocystidiis similia. Pillipellis hymeniformis, cellulis sphaero-pedunculatis composita. Caulocystidia 14-52.5 x 7.5-25 μm, versiformia. Hyphae fibulatae. Ad fimum *Elephas maximus*.

Typus: India, Kerala State, Thrissur District, Guruvayoor, 14 July 1999, K. A. Thomas T316 (L, holotypus).

Basidiomata fragile. Pileus 15–60 mm diam., convex becoming plano-convex or plane; surface light yellow (4A4), pale orange (5A3) or light orange (5A4) towards disc, yellowish white (4A2) or pale yellow (4A3) towards margin, glabrous, sometimes with scattered, shallow pits, faintly translucent-striate towards margin when moist; margin decurved, becoming plane, entire when young, turning fissile with maturity. Context up to 3.5 mm thick at the centre, white or with a tint of yellowish white (4A2). Lamellae adnexed, light brown (6D4, 6D5) or brown (6E6, 7E6), subcrowded to crowded, up to 7 mm wide, with lamellulae of different lengths; edge pale, scalloped under a lens. Stipe 30–140 x 2–8 mm, fragile, central, terete, tapering towards apex, hollow; surface yellowish white (4A2, 4A3) or orange white (5A2), pruinose towards apex, elsewhere glabrous, with faint longitudinal striations, with a median annulus, concolorous with the stipe, up to 4 mm wide, evanescent. Odour not distinctive. Spore-print dark brown (7F5, 7F6).

Spores 9–13.5 x 6.5–9 x 6–8 (11.25±1.26 x 7.47±0.55 x 6.97±0.47) μm, Q=1.33–1.68, Qm=1.50, lenticular, ovoid to ovo-ellipsoid in face-view, ellipsoid in side-view, melleous brown, smooth, thick-walled, apically truncated by a germ-pore up to 1 μm wide. Basidia 22–28 x 8.5–12 μm, clavate, 4-spored; sterigmata up to 4 μm long. Lamella-edge sterile. Cheilocystidia 11.5–60 x 9–27.5 μm, subglobose, sphaeropedunculate, utriform or clavate, thin-walled, hyaline. Pleurocystidia very infrequent, similar to cheilocystidia. Hymenophoral trama regular; hyphae 2–22.5 μm wide, thin-walled, hyaline. Pileal trama interwoven; hyphae 1.5–24 μm wide, thin-walled, hyaline to pale yellow. Pileipellis hymeniform; elements 20–57.5 x 17.5–40 μm, sphaeropedunculate, thin-walled, hyaline to pale yellow. Stipe trama parallel; hyphae 2–27.5 μm wide, thin- to slightly thick-walled, hyaline to pale yellow. Stipitipellis a cutis; hyphae 2–17 μm wide, thin- to slightly thick-walled, pale yellow to hyaline. Caulocystidia 14–52.5 x 7.5–25 μm, variable: utriform, oblong, subglobose,

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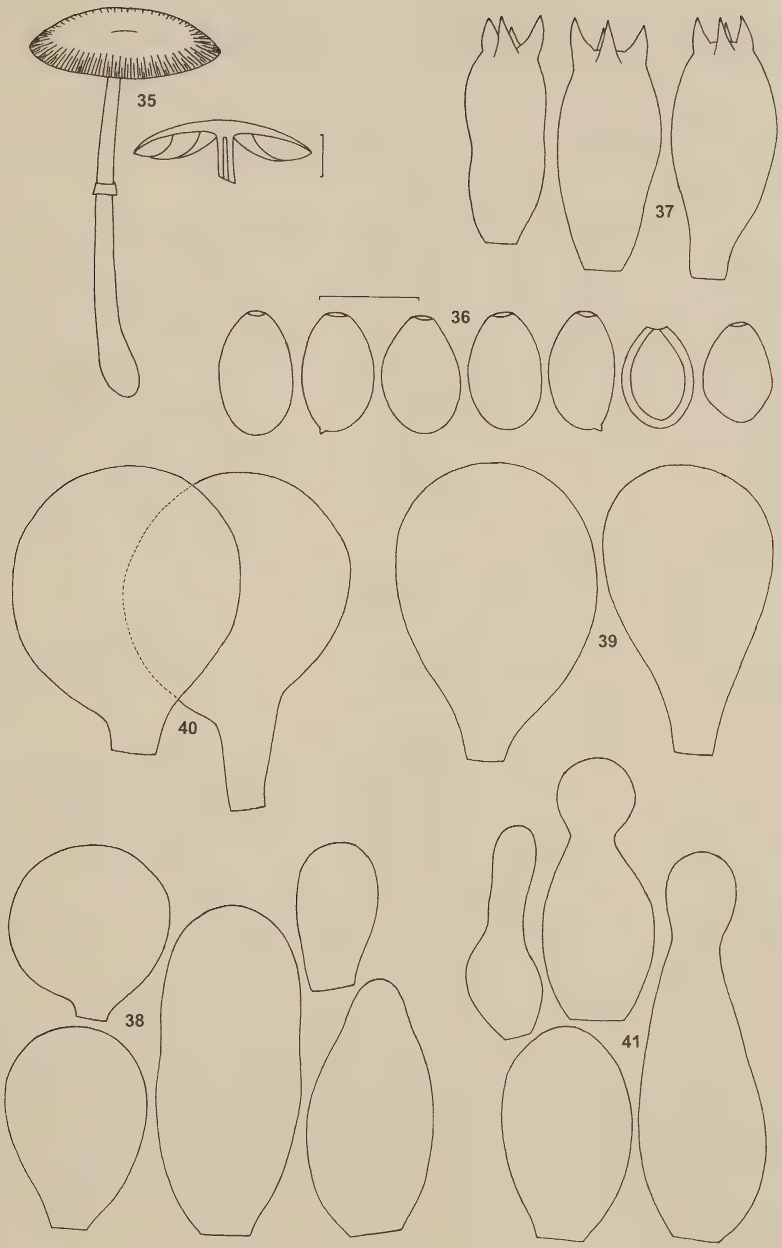
Figs. 35-41, *Agrocybe guruvayoorensis*: 35, basidioma; 36, spores; 37 basidia; 38, cheilocystidia; 39, pleurocystidia; 40, elements of pileipellis; 41, caulocystidia; scale bar = 10 mm for basidioma and 10 μm for microstructures.



clavate or fusoid, frequently with a subcapitate apex. In clusters or scattered, thin-walled, hyaline, restricted to the upper part of the stipe. Clamp-connexions present.

On elephant dung, scattered, July-October.

Specimens examined: India, Kerala State, Thrissur District, Guruvayoor: 14 July 1999, K. A. Thomas T316; 16 July 1999, K. A. Thomas T316b; 21 July 1999, K. A. Thomas T316c; 18 October 1999, K. A. Thomas T316d (all at L).

Pale yellow pileus, stipe with an evanescent but distinct median annulus, spores that are 9–13.5 μm long and with a truncate germ-pore, sphaeropedunculate to vesiculose cheilocystidia, infrequent pleurocystidia that are similar to cheilocystidia, and caulocystidia restricted to the upper part of stipe are the characteristic features of this species which belongs to the subgenus *Agrocybe*, section *Agrocybe*. It is very close to *Agrocybe molesta* (Lasch) Singer, and *A. howeana* (Peck) Singer because of several shared characters. *Agrocybe molesta*, however, has cracking pileal surface, veil forming an appendiculate margin to the pileus or forming cottony ring-zones on the stipe and different cystidial morphology. Moreover, it lacks clamp-connections and grows on soil. *Agrocybe howeana* has cracking pileal surface, a disagreeable odour, and smaller spores and it grows on soil. *Agrocybe paludosa* (J. E. Lange) Kühner & Romagn. also looks remarkably similar differing only in spore size and habitat.

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A NEW SPECIES, CERIPORIA LACERATA, ISOLATED FROM WHITE-ROTTED WOOD

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ABSTRACT

Ceriporia lacerata (Aphyllophorales, Basidiomycota) is described from a ripe basidiocarp successfully developed in a culture isolated from a white-rotted tree on Kyushu Island, Japan. Cultural characteristics, microscopical data and DNA sequencing are given as support for the generic position. A key to the Japanese species of *Ceriporia* is provided.

Keywords: basidiomycetes, dioxins, Japan, polypores

INTRODUCTION

White-rot fungi are able to degrade lignin, a biopolymer in wood and woody plants that is resistant to attack of most microorganisms (Sarkanen & Ludwing 1971). Some of these fungi also have the ability to degrade a wide variety of recalcitrant environmental pollutants (Aust & Stahl 1998, Bumpus, Tien & Wright 1985) and/or potential pollutants like polycyclic aromatic hydrocarbons (PAHs). Kondo *et al.* (1999) reported that MZ-340, a fungal strain isolated from white rotten wood, could degrade polychlorinated dibenzo-*p*-dioxines (PCDDs) and polychlorinated dibenzofrans (PCDFs). However, strain MZ-340 has not been identified, because we could not obtain any basidiomata associated with this strain in the field.

Basidiomycetes are usually identified by morphology of their basidiomata. There are some identification manuals for wood-inhabiting basidiomycetes based on cultural characteristics (Nakasone 1990, Stalpers 1978), but identification without basidioma is difficult in many cases. Recently, phylogenetic analyses of basidiomycetous fungi using ribosomal DNA have been carried out widely, and have revealed phylogenetic relationships within Homobasidiomycetes (Boidin, Muginier & Canales 1998, Swann & Taylor 1993, Hibbett & Donoghue 1995, Hibbett *et al.* 1997, Hibbett, Gilbert & Donoghue 2000). We applied this technique to reveal the phylogenetic position of the isolate MZ-340.

The aim of this study was to identify the strain MZ-340 based on analyses of a partial sequence of the 18S rDNA and on morphological observation of basidiomata artificially induced from the strain.

MATERIALS AND METHODS

Incubation to induce basidiomata from MZ-340

A white-rot fungal strain, MZ-340, was isolated from decayed wood of a broadleaf tree in September 1994 in a natural forest in the Miyazaki Forest of Kyushu University Forests, located in Shiiba village, Miyazaki Prefecture situated in a warm temperate area of Japan. Branches of *Quercus acutissima* Carr., 80–120 cm long and about 3–5 cm diameter, were used to induce basidiomata from the mycelium of MZ-340 as a substrate. Several holes, 1.5 cm diameter and 2–3 cm deep, were drilled in each branch. Each hole of the branches was inoculated with the beech chips (80–120 mesh) colonized by the mycelium of MZ-340 and then capped with outer bark of *Q. acutissima*. Branches of a broadleaf tree, 20 cm long and about 10 cm diameter, were also inoculated with the mycelium by the same method as mentioned above. Some of the inoculated branches of *Q. acutissima* and the broadleaf tree were put on the forest floor from June 16 to Oct. 18, 2000 and the other to 2001 June at Fukuoka Prefecture Forest Research & Extension Center in Toyota Yamamoto-Cho, Kurume City, Fukuoka Prefecture and on the ground of forest of *Cryptomeria japonica* D. Don plantation and covered with black mesh sheet from 1998 to 1999 at the Research Institute Kyushu University Forest in Sasaguri, Fukuoka Prefecture, respectively.

Description of basidiomata characteristics

Morphological characteristics were described for the specimens of the artificially induced basidiomata of MZ-340. Specimens of the related species were also examined. The colors of the basidiomata were given according to Rayner (1970). Herbaria where specimens are deposited are abbreviated according to Holmgren, Holmgren & Barnett (1990).

DNA isolation

In addition to MZ-340, basidiomycetous strains listed in Table 1 were examined to reveal the phylogenetic position of MZ-340. The table also lists DNA Data Bank of Japan (DDBJ) /GenBank/European Molecular Biology Laboratory (EMBL) accession numbers of the sequences used in this study. We obtained these strains from the American Type Culture Collection (ATCC), Center for Forest Mycology Research, Forest Products Laboratory, USDA Forest Service (USDA), Institute for Fermentation Osaka (IFO), the Tottori Mycological Institute (TMI) and the Laboratory of Systematic Forest and Forest Products Science, Kyushu University (SFFPS).

For DNA extraction, mycelium was grown at room temperature or 30 °C on potato dextrose agar (PDA: Difco) or on a 1.5 % (w/v) malt extract (Difco), 1.5 % (w/v) agar (Wako) plate. The mycelium was then placed with liquid nitrogen in a mortar and ground with a pestle into a fine powder. The mycelium powder was transferred to another mortar and grounded with CTAB2 buffer [2 % (w/v) cetyltrimethylammonium bromide (CTAB: Wako); 1.4 M NaCl (Wako); 0.1 M Tris-HCl; 0.1 % (v/v) ß-mercaptoethanol (Wako); 20 mM EDTA (Wako); 2 % (w/v) polyvinylpyrrolidone (PVP: Wako): pH 9.0] with 50 μg /ml of RNase A (TaKaRa). The mixture was incubated at 65 °C for 30 min. The lysate was extracted with the same volume of chloroform (Wako) twice. The same volume of 2-propanol (Wako) was added to the aqueous layer to precipitate DNA. The precipitated pellet was dissolved with sterile MilliQ water at 4 °C overnight. The mixture was further centrifuged at $\geq$ 10000 g, 15 min, and the supernatant was used.

PCR amplification

PCR amplification was performed for the 18S rDNA, using the primers EukNS20F (5'-TGTAGTCATATGCTTGTCTCAA-3') and EukNS1750R (5'-TCCTCTAAATGA CCAAGTTTG -3') (Dams *et al*. 1988). Amplifications were performed using TaKaRa EX-Taq DNA polymerase (TaKaRa) in a thermal cycler (PC801; ASTEC). PCR reactions consisted of an initial denaturation at 94 °C for 90 s, 32 cycles of amplification, and a final extension at 72 °C for 5 min; each cycle of amplification consisted of denaturation at 94 °C for 30 s, annealing at 55 °C for 30 s, and extension at 72 °C for 2 min. PCR products were observed by electrophoresis on 1 % (w/v) agarose gel containing ethidium bromide in Tris-acetate EDTA (TAE) buffer (40 mM Tris- acetate; 1 mM EDTA: pH 8.0). The presence of a single bright band in each lane indicated a successful amplification. A negative control, containing all components except a DNA template, was always included to detect any possible contamination during the PCR. The PCR products were purified with the QIAquick PCR purification kit (QIAGEN).

Direct sequence

Direct sequencing was performed on an ABI PRIZM 377 (Applied Biosystems Japan

Ltd.) genetic analyzer, using cycle sequencing with the BigDye Terminator Cycle Sequencing Ready Reaction Kit (Applied Biosystems Japan Ltd.), 100 ng of purified PCR fragment, and 3.2 pmol primer per reaction. The amplified 18S rDNA fragments were sequenced using the primers EukNS600R (5'-ATACGCTATTGGAGCTGGAA-3'), EukNS581F (5'-TCCCAGCTCCAATAGCGTAT-3'), EukNS1165R (5'-CCTGGT GGTGCCCTTCC-3') and EukNS1149F (5'-GGAAGGGCACCACCAGG-3') in addition to the primers listed above.

Phylogenetic analysis

Sequences were edited with the Genetyx-Mac 9.0 program (Software Development Co., Ltd.). Sequence was subjected to a BLAST Search via by the National Center for Biotechnology Information (NCBI; http://www.ncbi.nlm.nih.gov/blast/index.html). The following sequence data were obtained from the DDBJ/GenBank/EMBL: L22254 [*Auricularia auricula-judae* (Fr.) J. Schröt. 1888], L22255 [*Auricularia polytricha* (Mont.) Sacc. 1885], U59065 [*Bjerkandera adusta* (Willd.) P. Karst. 1879], L22257 [*Dacrymyces chrysospermus* Berk. & M. A. Curtis 1873], L22258 [*Dacrymyces stillatus* Nees:Fr. 1816], AF026605 [*Laxitextum bicolor* (Pers.) Lentz 1955], AF026593 [*Phanerochaete chrysosporium* Burds. 1974], and AF026587 [*Stereum annosum* Berk. & Broome 1873]. The four species of *Auricularia* Bull. ex Juss. 1789 and *Dacrymyces* Nees 1816 were chosen as outgroups based on the works of Hibbett *et al.* (1997, 2000). The sequences were aligned by the CLUSTAL X version 1.63b [parameter sets: 'gap opening' was 10.00, 'gap extension' was 0.05, 'delay divergent sequences (%)' was 40, 'DNA transition weight' was 0.5, 'use negative matrix' was off, and the IUB DNA weight matrix was used] (Thompson *et al*. 1997) and the SeqPup 0.6f (Gilbert 1996). Phylogenetic analysis was performed using the algorithm of the neighbor-joining (NJ) method (Saitou & Nei 1987) (NEIGHBOR) in the PHYLIP 3.572 package (Felsenstein 1993) based on Kimura's two-parameter method (Kimura 1980). To evaluate the strength of support for branches of NJ trees, 100 replications of bootstrap (Felsenstein 1985) analysis were calculated by the SEQBOOT program in PHYLIP. The tree was displayed using the TreeView PPC 1.5.3 program (Page 1998).

Confirmation of the induced basidiomata

To confirm that the induced basidiomata are identical with MZ-340, DNA was extracted from each basidioma and sequenced by the same method as above. Sequence was also performed for ITS region, ITS1~5.8S rDNA~ITS2, using the primers ITS1 (5'-TCCGTAGGTGAACCTGCGG-3') and FO-514 (5'-**CAGGAAACAGCTATGA**CCTATGCTTAAGTTCAGCGGGTAGTCC-3') (White *et al.* 1990) same method as above. Bold letters show the sequence that codes M13 (RV)-universal primer.

Table. 1 Organisms and DDBJ accession number

Fungal name	Strain no.	DDBJ accession no.
Auricularia auricula-judae		L22254
Auricularia polytricha		L22255
Bjerkandera adusta		U59065
Ceriporia purpurea	KKN-223-Sp (USDA)	AB084586
Ceriporia reticulata	24995 (ATCC)	AB084587
Ceriporia spissa	62024 (ATCC)	AB084588
Ceriporia tarda	KY-214 (USDA)	AB084591
Ceriporia viridans	HHB-9594-Sp (USDA)	AB084592
Ceriporiopsis aneirina	FP-100665-Sp (USDA)	AB084589
Ceriporiopsis pannocincta	L-15836-Sp (USDA)	AB084590
Dacrymyces chrysospermus		L22257
Dacrymyces stillatus		L22258
Hericium erinaceum	SFFPSC02 (SFFPS)	AB084622
Laxitextum bicolor		AF026605
Phanerochaete avellanea	HHB-9371-Sp (USDA)	AB084594
Phanerochaete brunnea	TMIC33977 (TMI)	AB084595
Phanerochaete chrysosporium		AF026593
Phanerochaete magnoliae	TMIC33868 (TMI)	AB084596
Phanerochaete sanguinea	FP-105385-Sp (USDA)	AB084597
Phanerochaete sordida	YK-624 (SFFPS)	AB084593
Phanerochaete stereoides	TMIC33983 (TMI)	AB084598
Phanerochaete velutina	RLG-11272-Sp (USDA)	AB084599
Phlebia brevispora	HHB-7024-Sp (USDA)	AB084600
Phlebia chrysocreas	TMIC31891 (TMI)	AB084601
Phlebia livida	HHB-4609-Sp (USDA)	AB084602
Phlebia radiata	HHB-5324-Sp (USDA)	AB084603
Phlebia subochracea	HHB-8494-Sp (USDA)	AB084604

Table. 1 (continued)

Fungal name	Strain no.	DDBJ accession no.
Phlebia subserialis	HHB-9678-Sp (USDA)	AB084605
Phlebia uda	Kropp-1 (USDA)	AB084606
Pycnoporus coccineus	SFFPSC01 (SFFPS)	AB084612
Trametes hirsuta	YK-505 (SFFPS)	AB084607
Trametes versicolor	6482 (IFO)	AB084608
Xylobolus annosus (*Stereum annosum*)		AF026587
Xylobolus frustulatus	4932 (IFO)	AB084609
Xylobolus subpileatus	7076 (IFO)	AB084610
Ceriporia lacerata	MZ-340 (SFFPS)	AB084585

Abbreviations in parentheses are shown United States of Agriculuture (USDA) Forest Products Laboratory, American Type Culture Collection (ATCC), the Tottori Mycological Institute (TMI), Institute for Fermentation Osaka (IFO) and Laboratory of Systematic Forest and Forest Products Sciences (SFFPS), Kyushu University.

RESULTS

Phylogenetic analysis of the strain MZ-340 using the 18S rDNA sequence

A partial sequence of 18S rDNA (approximately 1700 bp) obtained from the fungus MZ-340 was subjected to a BLAST search as a first step. This search showed that the fungus is closely related to *Phanerochaete* P. Karst. 1889, *Phlebia* Fr. 1821 or *Ceriporia* Donk 1993 (~ 98% identical) among the examined basidiomycetous fungi. Based on those results, subsequent phylogenetic analysis was done, using mainly the species *Phanerochaete*, *Phlebia* and *Ceriporia*. The phylogenetic tree was obtained from overlapping data sets of the 18S rDNA. Informative sites (defined by the presence of any gaps, ambiguity symbols and unconsensus sequence on each site) included those at 271/1610. Figure 1 shows a phylogenetic tree obtained from NJ analysis with 100 replications of bootstrap value (90/100). A clade of *Ceriporia* - *Ceriporiopsis* Domanski 1963 was well isolated from *Phanerochaete* and *Phlebia* lineage, as it was supported by a high bootstrap value (90/100). The clade of *Ceriporia* taxa formed a completely monophyletic lineage (bootstrap value 81/100). MZ-340 was nested into the *Ceriporia* monophyly.

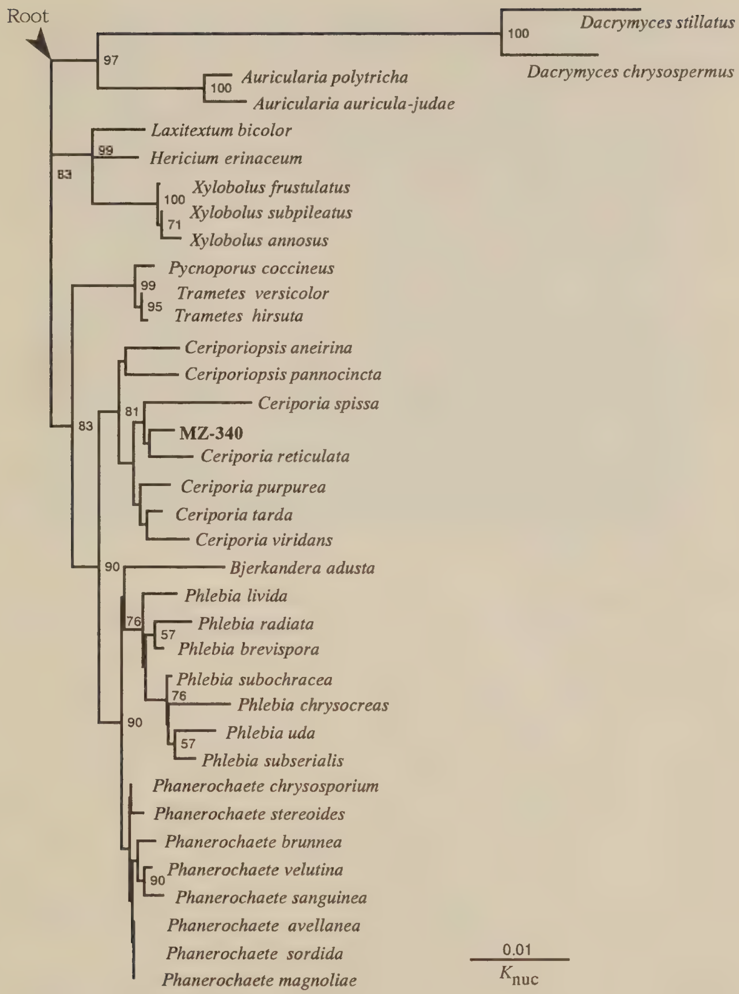
Root
97
100
Dacrymyces stillatus
Dacrymyces chrysospermus
100
Auricularia polytricha
Auricularia auricula-judae
Laxitextum bicolor
99
Hericium erinaceum
83
100
Xylobolus frustulatus
Xylobolus subpileatus
71
Xylobolus annosus
Pycnoporus coccineus
99
Trametes versicolor
95
Trametes hirsuta
Ceriporiopsis aneirina
Ceriporiopsis pannocincta
81
Ceriporia spissa
83
MZ-340
Ceriporia reticulata
Ceriporia purpurea
Ceriporia tarda
Ceriporia viridans
90
Bjerkandera adusta
Phlebia livida
76
Phlebia radiata
57
Phlebia brevispora
Phlebia subochracea
76
Phlebia chrysocreas
90
Phlebia uda
57
Phlebia subserialis
Phanerochaete chrysosporium
Phanerochaete stereoides
Phanerochaete brunnea
90
Phanerochaete velutina
Phanerochaete sanguinea
Phanerochaete avellanea
Phanerochaete sordida
Phanerochaete magnoliae
0.01
Knuc

Fig. 1. Neighbor-joining tree derived from partial 18S rDNA sequences. Arrowhead indicates the root. The tree was rooted by outgroup using a sequence of heterobasidiomycete "jelly fungi". Bootstrap values ≥ 50% are indicated. The bar indicates a distance of 0.01 nucleotide substitution per site.

Characteristics of basidiomata artificially grown from the mycelium of MZ-340

The fungus MZ-340 produced basidiomata under the artificial conditions examined. Basidiomata produced on the branch and log of *Q. acutissima* and twigs of a broadleaf tree are resupinate with denticulate to poroid hymenophore (Fig. 2). The induced specimens are microscopically characterized by the clavate basidia, the monomitic hyphal system, the clampless hyphae, and the lack of cystidia. These characteristics are those of the genus *Ceriporia* together with the resupinate basidiomata and a white rot. The sequences of 18S rDNA (approximately 1650 bp) and ITS region (approximately 550 bp) from artificial basidioma were identical to that of mycelial strain MZ-340.

Taxonomy

Ceriporia lacerata N. Maek., Suhara & R. Kondo, sp. nov.

Basidiomata resupinata, adnata; superficies hymenialis alba, "Buff", "Ochreous" vel "Fulvous" (sec. Rayner, 1970), poroidea (poris 2–6 per mm), lacerata vel denticulata; margo alba, gracilescenssub lente (×20) fibrillosa. In sectione subhyalina, membranacea. Systema hypharis monomitica; hyphae 2.5–6 μm diametro, laeves, tennui- vel parum crassitunicatae (usque 0.75 μm), simpliciseptatae; cystidiis carentes; basidia clavata, fibula basali carentia, 12.5–16 × 4.5–5 μm, sterigmata 4 efferentia; basidiosporae ellipsoideae, 4.25–5 × 2.5–2.75 μm, laeves, tenuitunicatae, non amyloideae.

Basidiomata resupinate, adnate, effused, soft when fresh, fragile, sometimes cracked when dried; hymenophore poroid to denticulate, dissepiments entire to lacerate, pores angular, 2–6 per mm, pore surface white, "Buff", "Ochreous" to "Fulvous" (based on Rayner, 1970); context white, up to 300 μm thick; tube layer concolorous with the context, up to 3 mm thick; margin white, thinning out, sometimes fibrillose in the lens (×20), in vertical section subhyaline, membranous. Hyphal system monomitic; contextual hyphae 2.5–6 μm in diameter, smooth, thin- to slightly thick-walled (up to 0.75 μm), clampless-septate; tramal hyphae 2.5–5 μm in diameter, smooth, thin- to slightly thick-walled (up to 0.75 μm), clampless-septate, occasionally encrusted with crystalloid materials; cystidia lacking; basidia clavate, 12.5–16 × 4.5–5 μm, without a basal clamp, producing 4 sterigmata; basidiospores oblong-ellipsoid to ellipsoid, 4.25 –5 × 2.5 –2.75 μm (ave. 4.5±0.3 × 2.6±0.1 μm, n=20), smooth, thin-walled, non-amyloid.

Ceriporia lacerata is characterized by having a white, "Buff", "Ochreous" to "Fulvous", poroid (pores angular, 2–6 per mm) to denticulate hymenophore with frequently lacerate dissepiments and oblong-ellipsoid to ellipsoid basidiospores measuring 4.25–5 × 2.5–2.75 μm (Fig. 2).

HOLOTYPE: locality: Japan, Kyushu Island. On a branch of *Quercus acutissima* Carr. inoculated with the strain MZ-340 (TMI25485, TMI); ISOTYPE: on a log of *Q. acutissima* inoculated with the strain MZ-340 (TMI25486, TMI); Shishizuka, Tsuchiura, Ibaraki Pref., on hardwood, 1 Sept. 2001, coll. by T. Hattori (F-19868, TFM).

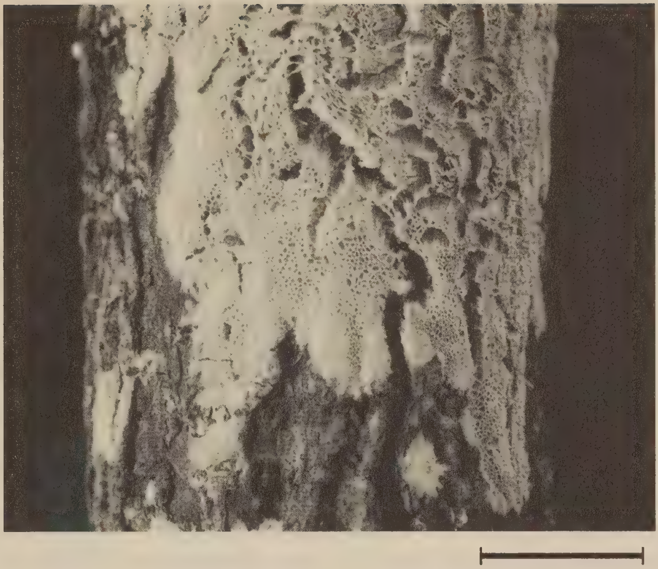

Fig. 2. Basidiomata of *Ceriporia lacerata* (specimen no. TMI 25485; strain MZ-340). Basidiomata developed on a twig of *Quercus acutissima*. *Bar* 1 cm.

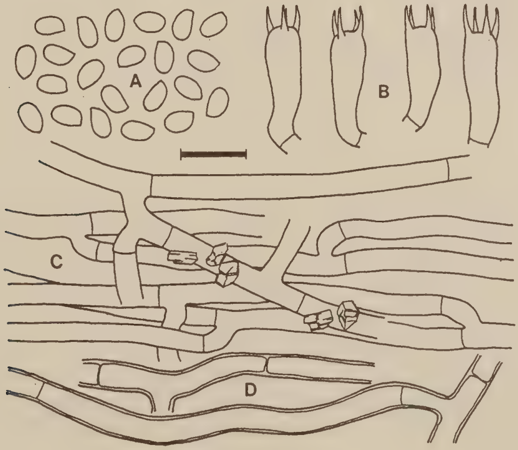

Fig. 3. *Ceriporia lacerata*. (specimen no. TMI 25485; strain MZ-340). **A.** Basidiospores. **B.** Basidia. **C.** Tramal hyphae. **D.** Contextual hyphae. *Bar* 10 μm.

Species related to *C. lacerata* examined

Ceriporia alachuana (Murrill) Hallenb. 1979. For a description of *C. alachuana*, see Gilbertson & Ryvarden (1986). Morphological characteristics of the species is as follows: basidiomata resupinate; pore surface white, "Buff", "Ochreous to "Fulvous"; hymenophore poroid, pores angular, 3–8 per mm, dissepiments entire; basidiospores cylindrical to oblong-ellipsoid, 3.5–4.5 × 2–2.5 μm (Fig. 4).

Specimens examined: Prairie Creek Hammock, Alachua County, Florida, on a hardwood log, 27 Mar. 1938, W.A. Murrill F16157 (HOLOTYPE, NY; ISOTYPE, US0237871, US0237875, BPI); Gainesville, Florida, on hardwood log, 25 Sept. 1959, Lowe No. 11510 (BPI, US0237870); Hughes, Arkansas, on hard wood, 27 Aug. 1951, Lowe No. 5150 (BPI, US0237874); Leland, Mississippi, on hardwood, 17 Aug. 1951, Lowe No. 5005 (BPI, US0237872); Paradise Hammock, Homestead, Florida, on hardwood, 8 Sept. 1950, Lowe No. 4364 (BPI, US0237876); Ammendale Road near Beltsville, Maryland, on a board in a sawdust pile, 25 May 1953, FP103881 (BPI, US0237873); Orange Park, Clay Co., Florida, on *Magnolia virginiana* (decaying wood), 12 July 1952, FP103244 (BPI, US0237877); on pecan (Carya), Olustee, Florida, 24 Sept. 1959, Lowe No. 11215 (BPI, US0237869); Soucier, Mississippi, on hardwood (decaying branch), 10 Aug. 1951, Lowe No. 4901 (BPI, US0237765); Slidell, Louisiana, on Nyssa (decaying wood), 28 Jun. 1952, (BPI, US0237878).

Ceriporia ferruginicincta (Murrill) Ryvarden 1980. For a description of *C. ferruginicincta*, see Gilbertson & Ryvarden (1986). The holotype of this species has the following characteristics: basidiomata resupinate; pore surface "Ochreous", "Fulvous" to "Umber"; hymenophore poroid, pores angular, 6–8 per mm, dissepiments entire; basidiospores short-cylindrical to oblong-ellipsoid, 4.5–5 × 2.75–3.25 μm (Fig. 4).

Specimens examined: Gainesville, Florida, on oak log, 7 Nov. 1932, W.A. Murrill F9127 (HOLOTYPE, NY; ISOTYPE, BPI, US0239496).

DISCUSSION

According to Search Aphyllophorales Database provided by Centraalbureau voor Schimmelcultures (CBS; http://www.cbs.knaw.nl/aphyllo/database.html), twenty-nine species have hitherto been reported for the genus *Ceriporia*. Among them, *C. lacerata* is similar to *C. alachuana* and *C. ferruginicincta* by having whitish to ochreous pore surface and oblong to ellipsoid basidiospores. However, as shown in Fig. 4, *C. lacerata* is distinguishable from both by the size of basidiospores. Basidiospores of *C. lacerata* are broader than those of *C. alachuana* and narrower than those of *C. ferruginicincta*, although the basidiospore lengths of the two species overlap each other. Furthermore, the specimens of *C. alachuana* and *C. ferruginicincta* examined in this study have pores with entire dissepiments (3–8 and 6–8 per mm, respectively), whereas the hymenophore of *C. lacerata* is variable in shape, i.e., poroid with larger

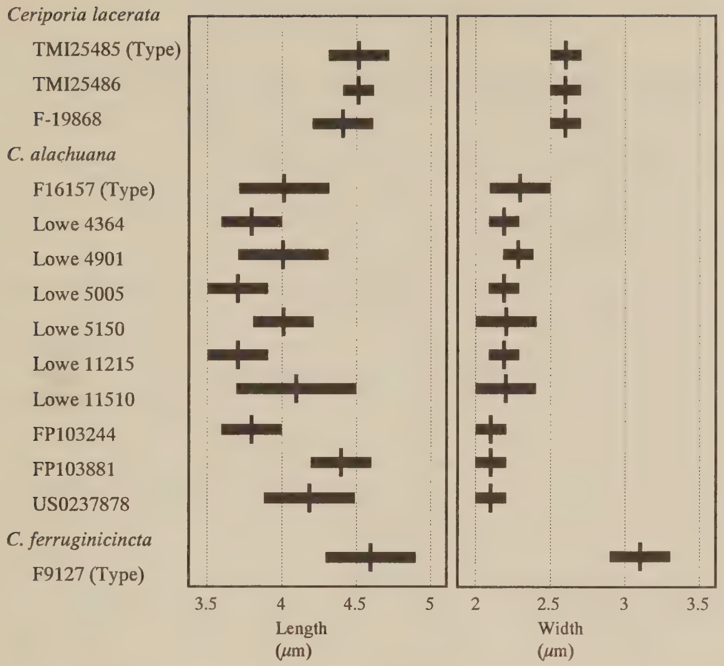

Fig. 4. Comparison of the basidiospore size between *Ceriporia lacerata* and two closely related species. Means (vertical bars) and standard deviation (rectangles) for each specimen were collected from measurements of 20 basidiospores selected randomly from each dried specimen.

pores (2–6 per mm) to dentate, with frequently lacerate dissepiments. The more or less irregular hymenophore of *C. lacerata* differ from those of not only *C. alachuana* and *C. ferruginicincta* but also from other members of the genus, which usually form regular poroid hymenophore. However, the microscopic features as mentioned above and the partial sequencing data of 18S rDNA strongly indicate that *C. lacerata* belongs to the genus *Ceriporia*.

Núñez and Ryvarden (2001) listed 7 species of *Ceriporia* hitherto collected from Japan. A key to the species of *Ceriporia* listed in Japan including *C. lacerata* are provided based on our observations in addition to the description by Núñez and Ryvarden (2001).

Key to the species of *Ceriporia* in Japan

1. Pore surface purple, orange, or reddish-orange ··········· 2
1. Pore surface white to tan ··········· 4

2. Pore surface purple; basidiospores, 5.5–6.5 × 1.75–2 μm ··········· *C. purpurea* (Fr.) Komarova 1964
2. Pore surface orange, reddish-orange or pink ··········· 3

3. Pore surface variable in color, white to pinkish or purplish tan when fresh; pores 2–3 per mm; basidiospores oblong to short-cylindrical, 3.5–5 × 2–2.5 μm ··········· *C. excelsa* (S.Lundell) Parmasto 1959
3. Pore surface orange when fresh; pores 7–9 per mm; basidiospores allantoid, 3–6 × 1.5–2 μm ··········· *C. spissa* (Schwein.: Fr.) Rajchenb. 1983

4. Basidiospores cylindrical to allantoid, 4–6 × 1.5–2 μm ···········*C. viridans* (Berk. & Broome) Donk 1933
4. Basidiospores broader than 2 μm ··········· 5

5. Basidiospores longer than 6 μm ··········· 6
5. Basidiospores shorter than 5 μm ··········· 7

6. Basidiospores suballantoid to allantoid, 7–8 × 2.5–3 μm ··········· *C. reticulata* (Hoffm.: Fr.) Domanski 1963
6. Basidiospores cylindrical to suballantoid, 6–8 × 3–3.5 μm ··········· *C. mellea* (Berk. & Broome) Ryvarden 1978

7. Basidiospores cylindrical to oblong-ellipsoid, 3.75–4.5 × 2–2.5 μm; hymenophore poroid, 3–8 per mm, dissepiments entire. ········ *C. alachuana*(Murrill) Hallenb. 1979
7. Basidiospores oblong-ellipsoid to ellipsoid, 4.25–5 × 2.5–2.75 μm; hymenophore poroid (pores 2–6 per mm) to denticulate, dissepiments frequently lacerate ··········· *C. lacerata*

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We wish to thank Dr. Karen K. Nakasone, Center for Forest Mycology Research, Forest Products Laboratory, USDA Forest Service, for providing fungal strains and specimens. Thanks are also extended to the curators of the New York Botanical Garden (NY) and the United States National Fungus Collections (BPI) for lending us numerous collections. We are grateful to Prof. L. Ryvarden, Department of Biology, University of Oslo, for critical reviewing.

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TAXONOMIC REVISION OF SIX TAXA IN THE LICHEN GENUS COLLEMA FROM CHINA

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ABSTRACT: Six taxa of the lichen genus *Collema* belonging to 5 species are reported in the present paper with the figures of type specimens of 5 revised taxa. The reexamination of the type and paratype specimens of 5 taxa shows *Collema brevisporum, C. multipartitum* var. *granulosum, C. corniculatum, C. tianmuense* and *C. pulcellum* var. *multipartitum* to be synonyms of *C. leptaleum* var. *leptaleum, C. multipartitum, C. pulcellum* var. *subnigrescens, C. subconveniens* and *C. subnigrescens* respectively.

KEY WORDS: Collemataceae, Lecanorales, lichenized ascomycetes

Introduction

Twenty-eight taxa of *Collema* belonging to 22 species were reported from China by about 20 authors up to the early 1990's (Wei, 1991; Wu, 1987). Afterwards, Jiang (1992) described 12 taxa belonging to 12 species new to science and reported 13 taxa belonging to 9 species new to China (Jiang, 1993). About 5 years later, Abbas & Wu (1998) added one more taxon to the *Collema* from China. To date 54 taxa of *Collema* belonging to 40 species are reported from China. During recent study on the genus from China we found that 5 taxa, *Collema brevisporum*, *C. multipartitum* var. *granulosum*, *C. corniculatum*, *C. tianmuense* and *C. pulcellum* var. *multipartitum* described by Jiang (1992) are synonyms of those taxa which have been reported from China by the following authors: Zahlbruckner (1933a, 1933b, 1940), Asahina (1952), Wang Yang & Lai (1973), Degelius (1974), Wu (1987), Thrower (1988), Chen et al. (1989), Wei (1991), Jiang (1993) and Abbas & Wu (1998).

Materials and Methods

The specimens examined in the present paper are deposited mainly in HMAS-L. The measurements were carried out using a compound microscope with hand sections mounted in water. Some terms of morphology and anatomy are used after Degelius (1954, 1974). The literature records for China are mainly based on Wei (1991).

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Results and Discussions

1. Collema leptaleum Tuck. var. leptaleum

Proceed. Amer. Acad. Arts and Sc. **6**: 263 (1864).

= *C. brevisporum* Z. G. Jiang, Journal of Hebei Normal University **16**(3): 83 (1992). syn. nov. Type: China, Jilin, Changbaishan, 1370 m, 1960.8.19, Y. C. Yang et al., 52 (HMAS-L). Paratype: China, Zhejiang, Tianmushan, 1000 m, 1962.9.2, J. D. Zhao, 6399 (HMAS-L). Fig. 1 & 2.

This variety is characterized by: 1) thallus subfoliose to crustose, upper side irregularly rugose; 2) isidia and pruina absent; 3) end lobes plane, not swollen, < 5 mm wide; 4) thallus and thalline exciple without pseudocortex; 5) proper exciple euparaplectenchymatous; 6) spores bacillar and 4-celled; 7) corticolous.

Selected specimens examined: JILIN, Mt. Changbaishan, 1977.8.8, J. C. Wei, 2791-1, 2793-3. HEILONGJIANG, Dailing, Liangshui, 420 m, 1975.10.12, J. C. Wei, 2280. YUNNAN, Xichou, Fadou, 1450 m, 1991.11.16, J. B. Chen, 5015-1.

Literature records for China: TAIWAN (Zahlbruckner, 1933b, p.26 & 1940, p.247; Wang Yang & Lai, 1973, p. 90; Degelius, 1974, pp.102 & 107), HONG KONG (Thrower, 1988, p.84).

The reexamination of the type specimens of *C. brevisporum* showed that the following characteristics were present: Thallus subfoliose to subcrustose, 3-4 cm diam., rounded to somewhat irregularly shaped, usually adnate. Upper side dark olive-green to blackish, glabrous, smooth or sparsely to densely and irregularly rugose, partly glossy, epruinose, not fenestrate, without isidia, partly with isidia-like outgrowths. Lobes sparse, plane, margin entire, somewhat crisped, not swollen, 1-3 mm wide. Apothecia sparse to dense, 1 mm diam., sessile, constricted at the base.

Thallus 75-112 μm thick, without pseudocortex on both sides.

Thalline exciple without pseudocortex. Proper exciple euparaplectenchymatous, 37-61 μm thick in center. Spores bacillar, straight to curved, usually 4-celled, 25-51×2-5 μm.

The wrinkles on upper side of *C. leptaleum* var. *leptaleum* were apparently confused with the ridges of the *Nigrescens* group by Jiang (1992), who put his new species *C. brevisporum* (= *C. leptaleum* var. *leptaleum*) in the *Nigrescens* group rather than in the *Leptaleum* group.

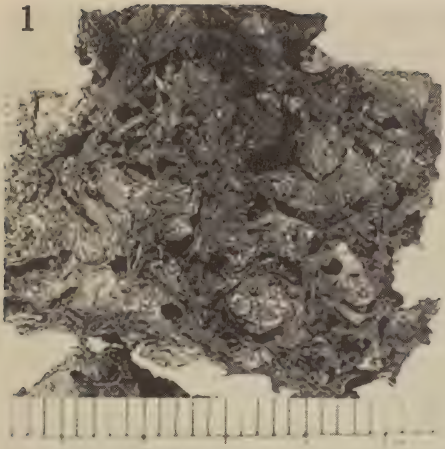
Fig 1-2. Thallus of the type specimen of *C. brevisporum*. 1. Upper side. 2. Lower side. Scale = 1 mm.

Fig. 3. Fragments of the thallus of type specimen of *C. multipartitum* var. *granulosum*. Scale = 1 mm.

Fig 4-5. Thallus of the paratype specimen of *C. pulcellum* var. *multipartitum*. 4. Upper side. 5. Lower side. Scale = 1 mm.

Fig. 6. Thallus of the type specimen of *C. corniculatum*. Scale = 1 mm.

1



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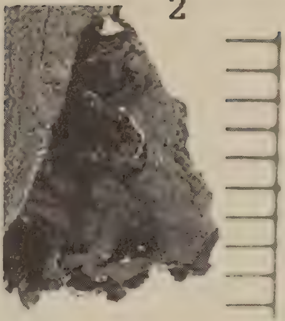

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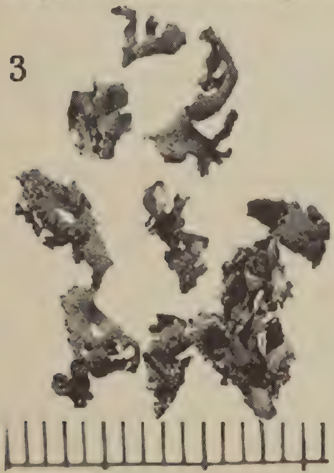

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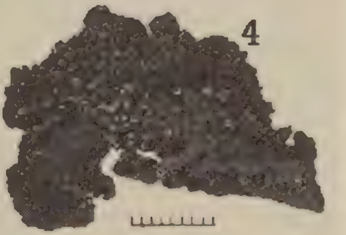

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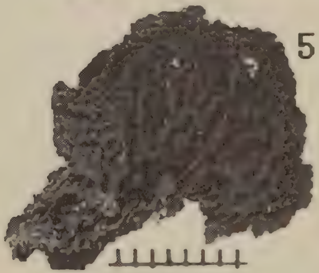

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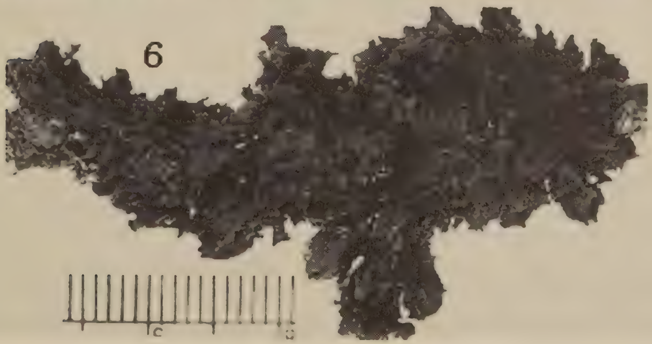

2. Collema multipartitum Smith

in Smith & Sowerby, Engl. Bot. : 36 (1814).

= *C. multipartitum* Smith var. *granulosum* Z. G Jiang, Journal of Hebei Normal University **16**(3): 86 (1992). syn. nov. Type: China, Hebei, Xiaowutaishan, Xitai, 2000 m, 1986.6, Z. G Jiang, 3583-1 (HMAS-L). Fig. 3.

This species is characterized by: 1) thallus foliose; 2) lobes repeatedly furcate, < 5 mm wide and convex near the margin; 3) thallus and thalline exciple without typical pseudocortex; 4) proper exciple euparaplectenchymatous; 5) spores linear-oblong, 4-celled; 6) saxicolous.

The reexamination of the type specimen of *C. multipartitum* var. *granulosum* showed that the following characteristics were present: Thallus foliose, very fragile, fragmented, deeply and richly lobate, without isidia and lobules. Upper side olive-green, glabrous, smooth, epruinose, partly glossy, not plicate, without ridges and pustules. Lower side paler, with sparse rhizines. Lobes numerous, somewhat repeatedly furcate and extended, margin not swollen or somewhat so, entire, end lobes 0.5-1 mm wide, with upper surface flattened to somewhat convex and lower surface flattened to somewhat concave. Apothecia sparse, superficial, sessile with constricted base, 1-1.5 mm diam; disc dark red, plane to somewhat irregularly convex, epruinose, with smooth and entire margin.

Thallus about 255-272 μm thick, without pseudocortex on both sides.

Thalline exciple without pseudocortex, 204-221 μm thick in the center. Proper exciple euparaplectenchymatous, 48-58 μm thick in the center, with cells globular to subglobular, > 8.5 μm diam. Hymenium 133 μm thick. Subhymenium 17-24 μm thick. Spores 8 per ascus, linear-oblong to somewhat bacillar, 4-celled, straight to somewhat curved, with usually obtuse ends, not constricted at the septa, colourless, (27) 34-37 (41) × (3.5) 5-7 μm. Saxicolous.

C. multipartitum var. *granulosum* is, according to the type specimen, not different from *C. multipartitum* var. *multipartitum*. In fact, no infraspecific taxon of *C. multipartitum* was accepted by Degelius (1954, 1974).

New to China.

3. Collema pulcellum Ach.

Syn. Meth. Lich.: 321 (1814).

3.1. var. pulcellum

C. pulcellum Ach. var. *multipartitum* auct. origin. p. p. non Z. G Jiang (type), Z. G. Jiang, Journal of Hebei Normal University **16**(3): 86 (1992). Paratype: China, Hubei, Shennongjia, 2200 m, 1984.7.3, J. B. Chen, 10027 (HMAS-L). Fig. 4 & 5.

Collema pulcellum Ach. var. *leucopeplum* auct. non. (Tuck.) Degel., Z. G Jiang, Journal of Hebei Normal University **17**(3): 72 (1993) (p. p.).

This variety is characterized by: 1) thallus of *nigrescens* type, mainly pustulate; 2) isidia and pruina absent; 3) thallus and thalline exciple without pseudocortex; 4) proper exciple euparaplectenchymatous; 5) spores acicular to somewhat linear fusiform, usually 6-celled, not constricted at the septa, often 51-65 × 3.5-5 µm.

Selected specimens examined: NEI MONGOL, Arxan, Bailang, 1300 m, 1991.8.18-19, J. B. Chen & Y. M. Jiang, 711-6 & A-664. HEILONGJIANG, Dailing, Liangshui, 500 m, 1975.10.2, J. C. Wei, 2065. JILIN, Mt. Changbaishan, 1100 m, 1977.8.8, J. C. Wei, 2807, 2810-1(Jiang (1993) as *C. pulcellum* var. *leucopeplum*). SHAANXI, Mt. Taibaishan, 2260 m, 1963.6.10, J. C. Wei et al., 2262. HEBEI, Mt. Xiaowutaishan, Zhongtai, 1934.7.17, Q. W. Wang, 982. ANHUI, Yuexi, Yaoluoping, 1500 m, 2001.9.5, H. J. Liu, 453; Jinzhai, Tiantangzhai, 1400 m, 2001.9.12, H. J. Liu, 668. HUNAN, Mt. Hengshan, 1000 m, 1964.8.31, J. D. Zhao & L. W. Xu, 9923. YUNNAN, Lijiang, Mt. Yulongshan, 3250 m, 1981.8.6, X. Y. Wang et al., 6542. FUJIAN, Pucheng, Jiumu, 600 m, 1960.8.8, Q. Z. Wang et al., 566. XINJIANG, Altay Shan, A. Abbas, 9800139.

Literature records for China: Northeast China (Degelius, 1974, p. 176), YUNNAN (Degelius, 1974, p. 176; Jiang, 1993, p.72), FUJIAN (Jiang, 1993, p.72).

The reexamination of the paratype specimen of *C. pulcellum* var. *multipartitum* showed that the following characteristics were present: Thallus of *nigrescens* type, foliose, 4-5 cm diam. Upper surface olive-green to blackish, glabrous, smooth, mainly pustulate, without isidia and pruina. Lobes sparse, entire, slightly downturned, somewhat crisped. Apothecia on pustules and ridges, numerous, dense, 1-1.5 mm diam., without pruina.

Thallus 90-120 µm thick, without pseudocortex on both sides.

Thalline exciple without pseudocortex. Proper exciple euparaplectenchymatous. Spores 8 per ascus, acicular to somewhat linear fusiform, 6 (-8)-celled, not constricted at the septa, colourless, (51) 58-61 (68) × 3.5-5 µm.

Jiang (1992) included two disparate elements in his original circumscription of *C. pulcellum* var. *multipartitum,* and indicated as difference between his new taxon and *C. pulcellum* var. *pulcellum* the presence of 12-16-celled spores. However, the authors were unable to find such spores when reexamining the paratype specimen of *C. pulcellum* var. *multipartitum*.

3.2. var. subnigrescens (Muell. Arg.) Degel.

Symb. Bot. Upsal. **20**(2): 173 (1974).

= *C. corniculatum* Z. G. Jiang, Journal of Hebei Normal University **16**(3): 85 (1992). syn. nov. Type: China, Yunnan, Menghai, Manjie Reserve, 1350-1400 m, 1981.1.3, Jiang Y. M., 1114-5 (HMAS-L). Fig. 6.

C. complanatum auct. non Hue, Z. G. Jiang, Journal of Hebei Normal University **17**(3): 72 (1993).

C. pulcellum Ach. var. *leucopeplum* auct. non. (Tuck.) Degel., Z. G. Jiang, Journal of Hebei Normal University **17**(3): 72 (1993) (p. p.).

C. pulcellum Ach. var. *pulcellum* auct. non Ach., Z. G. Jiang, Journal of Hebei Normal University **17**(3): 72 (1993) (p. p.).

This variety, a member of the *Nigrescens* group, is often confused with other taxa of the same group, especially the main type and *C. complanatum*.

It differs from the main type in: 1) thallus mainly ridged; 2) spores acicular to somewhat fusiform, usually 6-8-celled, often 34-65 × 5-8.5 μm. It differs from *C. complanatum* mainly in the spores, which are shorter (< 65 μm), wider and acicular to somewhat fusiform in the former, but longer (> 65 μm), narrower and acicular in the latter.

Selected specimens examined: HEILONGJIANG, Huzhong, 500 m, 1984.9.1, X. Q. Gao, 310 (Jiang, 1993 as *C. pulcellum* var. *leucopeplum*). SHAANXI, Mt. Taibaishan, 2700 m, 1988.7.10, C. H. Ma, 107. QINGHAI, Ledu, 2800 m, 1959.9.9, J. C. Xing & Q. M. Ma, 1528 (Jiang, 1993 as *C. pulcellum* var. *leucopeplum*). HUBEI, Shennongjia, 1800 m, 1976.7.8, P. C. Wu, 371-3. SICHUAN, Mt. Gongga Shan, 2650 m, 1982.7.2, X. Y. Wang et al., 8729; Mt. Emeishan, 2200 m, 1963.8.14, J. D. Zhao & L. W. Xu, 7325. GUIZHOU, Mt. Fanjingshan, 1963.8.21, J. C. Wei, 358-2. YUNNAN, Simao, 1960.11.19, J. D. Zhao & Y. B. Chen, 3144; Xishuangbanna, 650 m, 1980.12.21, Y. M. Jiang, 976-1 (Jiang, 1993 as *C. pulcellum* var. *pulcellum*), 570 m, 1982.8.28, L. S. Wang, 82-2790 (KUN 3453); Lijiang, 2900-3000 m, 1993.9.14, L. S. Wang, 93-13645 (KUN 13896); Judian, 1850 m, 1989.2.10, L. S. Wang, 89-440 (KUN 11110); Zhongdian, 3500 m, 1994.9.21, L. S. Wang, 94-15001 (KUN 15124). XIZANG, Zayü, Ridong, 3400 m, 1982.9.13, J. J. Su, 4643. HONG KONG, Cape d'Agailer, 1992.10.22, S. Thrower, 3262 (Jiang, 1993 as *C. complanatum*).

Literature records for China: HEILONGJIANG (Asahina, 1952, p.375; Degelius, 1974, p.176), YUNNAN (Degelius, 1974, p.176), HUBEI (Chen et al., 1989, p.420), TAIWAN (Wang Yang & Lai,1973, p.90), HONG KONG (Thrower, 1988, p.86).

The reexamination of the type specimen of *C. corniculatum* showed that the following characteristics were present: Thallus of *nigrescens* type, foliose, rounded, 3 cm diam. Upper side olive-green, glabrous, smooth, somewhat glossy, with regular ridges, without isidia and pruina. Lobes sparse, entire and somewhat crisped in margin. Apothecia not seen.

Thallus 82-99 μm thick, without pseudocortex or partly with poorly developed primitive pseudocortex.

Jiang (1992) separated *C. corniculatum* from all other taxa of *Collema* by the presence of the marginal corniculate lobules. But no such lobules were found by the authors on the type specimen.

4. Collema subconveniens Nyl.

Lich. Novae Zeland.: 8 (1888).

= *C. tianmuense* Z. G. Jiang, Journal of Hebei Normal University **16**(3): 84 (1992). syn. nov. Type: China, Zhejiang, Tianmushan, Laodian, on mossy rock, 1000 m, 1962.9.1, J. D. Zhao, 6265 (HMAS-L). Fig 7 & 8.

This species is characterized by: 1) thallus of *japonicum* type; 2) ridges and pustules usually absent; 3) often without isidia; 4) lobes > 5 mm wide,

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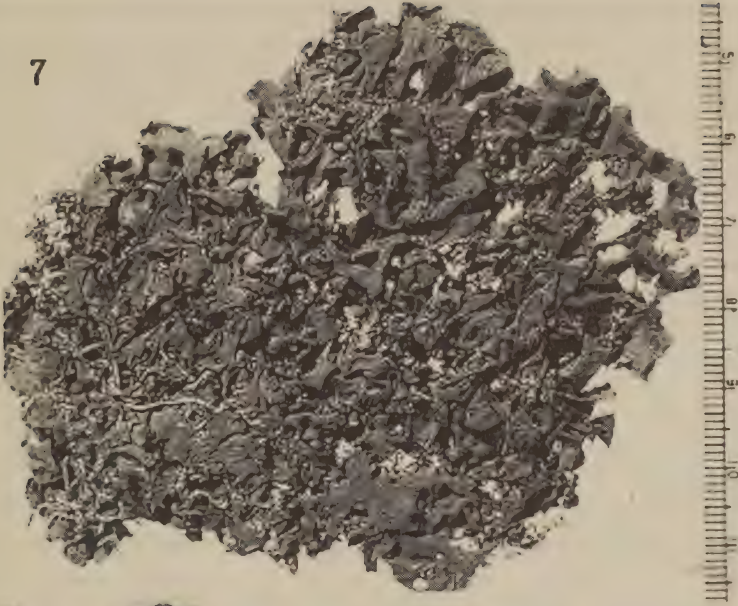
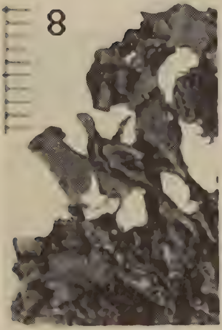
Fig. 7-8. Thallus of the type specimen of *C. tianmuense*. 7. Upper side. 8. Lower side. Scale = 1 mm.

Fig. 9-10. Thallus of the type specimen of *C. pulcellum* var. *multipartitum*. 9. Lower side. 10. Upper side. Scale = 1 mm.

7



8



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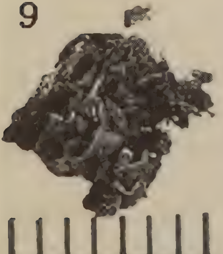

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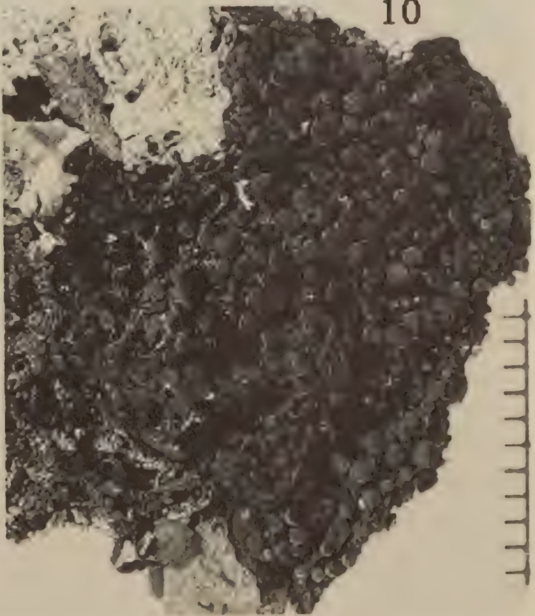

not swollen; 5) thallus and thalline exciple with typical pseudocortex; 6) proper exciple euthyplectenchymatous; 7) spores fusiform to oblong, submuriform, 17-44 × 7-12 μm.

Selected specimens examined: SHAANXI, Mt. Taibaishan, 3100 m, 1992.7.28, J. B. Chen & Q. He, 6132. HUBEI, Shennongjia, Bancang, 1200 m, 1984.8.17, J. B. Chen, 11805-2. YUNNAN, Lijiang, Mt. Yulongshan, 3050 m, 1964.10.5, J. C. Wei, 2532-1.

Literature records for China: HUBEI (Chen et al., 1989, p.421, misidentification of *Leptogium* sp.), XINJIANG (Abbas & Wu, 1998, p. 62).

The reexamination of the type specimen of *C. tianmuense* showed that the following characteristics were present: Thallus of *japonicum* type, foliose, rounded, 6-7 cm diam. Upper side olive-green to dark olive-green, glabrous, smooth, without ridges and pustules, epruinose, glossy, here and there with sparse squamiform isidia. Lower side olive-green, with sparse and white rhizines. Lobes rounded, 1-1.5 cm wide, margin entire, not crisped, not swollen, plane to downturned. Apothecia numerous, dense, 1-2 cm diam., without pruina, constricted at the base.

Thallus 80-120 μm thick, partly with primitive pseudocortex, without typical pseudocortex.

Thalline exciple without pseudocortex. Proper exciple euthyplectenchymatous, thin, 8.5-10 μm thick. Spores fusiform, 6-8-celled to submuriform, 31-34(41) × 8.5-10 μm.

Jiang (1992) indicated as differences between *C. tianmuense* and *C. subconveniens* the presence of submuriform spores and an euthyplectenchymatous proper exciple, and the rocky substrate. However, these characters are no deviation from the species definition by Degelius (1974). The authors were unable to find any other significant difference.

5. Collema subnigrescens Degel.

Symb. Bot. Upsal. **13**(2): 413 (1954).

= *C. pulcellum* Ach. var. *multipartitum* Z. G. Jiang, Journal of Hebei Normal University **16**(3): 86 (1992) (p.p.). Type: China, Hubei, Shennongjia, 2200 m, J. B. Chen, 11298 (HMAS-L). Fig. 9 & 10.

C. pulcellum Ach. var. *subnigrescens* auct. non. (Muell. Arg.) Degel., Z. G. Jiang, Journal of Hebei Normal University **17**(3): 72-73 (1993) (p. p.).

This species is characterized by: 1) thallus of *nigrescens* type, mainly ridged on upper side; 2) without isidia and pruina; 3) lobes > 5 mm wide, not swollen, not crisped, plane; 4) thallus and thalline exciple often with pseudocortex; 5) proper exciple usually euthyplectenchymatous; 6) spores usually irregularly clavate, usually 5-6-celled.

This species can be easily distinguished from *C. pulcellum* and *C. complanatum* by its pseudocorticate thalline exciple and euthyplectenchymatous proper exciple.

Selected specimens examined: HUNAN, Mt. Hengshan, Cangjingdian, 960 m, 1964.9.2, J. D. Zhao & L. W. Xu, 10315. SICHUAN, Huanglong, 3250-3300 m, 2001.9.23, Z. T. Zhao, et al., S172 & S178. YUNNAN, Lijiang, Mt. Yulongshan, 3050 m, 1964.12.15, J. C. Wei, 2497 (Jiang, 1993 as *C. pulcellum* var. *subnigrescens*). XIZANG, Zham, 2580 m, 1966.5.8, J. C. Wei & J. B. Chen, 391-2.

Literature records for China: SHAANXI (Wu, 1987, p.55).

The reexamination of the type specimen of *C. pulcellum* var. *multipartitum* showed that the following characteristics were present: Thallus of *nigrescens* type, foliose, 5 cm diam. Upper surface olive-green to dark olive-green, glabrous, smooth, partly glossy, mainly ridged, pustulate marginally, without isidia and pruina. Lower side olive-green, smooth, not glossy, rhizines sparse. Lobes sparse, rounded, ca. 1 cm broad, not swollen, entire, not crisped to slightly so. Apothecia on ridges and pustules, numerous, dense, ca. 1 mm diam., without pruina.

Thallus 85-102 μm thick, without pseudocortex on both sides.

Thalline exciple with typical pseudocortex. Proper exciple euthyplectenchymatous to somewhat subparaplectenchymatous. Spores 8 per ascus, clavate to acicular, usually 6-10-celled, colourless, not constricted at the septa, (51) 54-65 (85) × (3.5) 5-7 μm.

According to the reexamination of the type specimen, *C. pulcellum* var. *multipartitum* (type: J. B. Chen, 11298) is identical with *C. subnigrescens*, though the spores are 6-10-celled, unusual for *C. subnigrescens*.

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MYCOTAXON

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PARMELIACEAE (ASCOMYCOTA) LICHENS IN CHINA'S MAINLAND

II. THE GENUS HYPOTRACHYNA

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ABSTRACT: Twenty species of *Hypotrachyna* are recognized in China's mainland. One species, *H. neostictifera,* is described as new to science, and five species, *H. addita*, *H. croceopustulata*, *H. granulans*, *H. novella* and *H. physcioides,* are reported as new to China. A further five species, *H. adjuncta*, *H. exsecta*, *H. flexilis*, *H. imbricatula* and *H. koyaensis,* are recorded in China's mainland for the first time. Three species, *H. asiatica, H. ciliata* and *H. neostictifera,* are endemic to China.

KEY WORDS: *Hypotrachyna neostictifera,* new records, endemics

INTRODUCTION

Species of *Hypotrachyna* (Vainio) Hale are characterized by thalli with sublinear to subirregular lobes (1-5(-10) mm wide) with truncate to subtruncate or more rarely subrotund apices, a pored epicortex (lacking pseudocyphellae), the dichotomously branched rhizines which extend to or protrude beyond the lobe margins, the simple, medium sized ascospores and the bifusiform conidia. The genus *Hypotrachyna* is best developed in tropical montane regions with centres of speciation in South America (Hale 1975) and tropical Asia (Kurokawa & Lai 2001; Louwhoff & Elix 2002). Approximately 170 species of *Hypotrachyna* have so far been recorded worldwide. Wei (1991) recorded 9 species of *Hypotrachyna* from China's mainland: *H. adducta*, *H. ikomae*, *H. kokiuensis*, *H. nodakensis*, *H. osseoalba*, *H. pseudosinuosa*, *H. revoluta*, *H. sinuosa* and *H. sublaevigata*. Subsequently, Wang, Chen & Elix (2000) described two further species, *H. asiatica* and *H. ciliata,* which are endemic to China. The present study has revealed a further new species, *H. neostictifera,* five new records for China, *H. addita*, *H. croceopustulata*, *H. granulans H. novella*, and *H. physcioides*, and an additional five species, *H. adjuncta*, *H. exsecta*, *H. flexilis, H. imbricatula*, and *H. koyaensis* which are new records for China's mainland. *Hypotrachyna kokiuensis* (Zhao, Hsu & Sun) Wei (≡ *Parmelia kokiuensis* Zhao, Hsu & Sun), has previously been shown to be synonymous with *Parmelinopsis minarum* (Vain.) Elix & Hale (Chen *et al.* 2003). *Hypotrachyna sublaevigata* is not included in the present paper because we have not seen any authentic specimens of this species from China's mainland.

The specimens examined are housed in HMAS-L and SHM unless stated otherwise. Most chemical constituents were identified by thin layer chromatography (Culberson 1972; Culberson *et al.* 1981; Culberson & Johnson 1982; Elix & Ernst-Russell 1993), but where necessary their identity was confirmed by high performance liquid chromatography (Feige *et al.* 1993; Elix & Wardlaw 2000) and comparison with authentic samples.

Key to the species of *Hypotrachyna* in China's mainland

1. Vegetative propagules absent..2
1. Vegetative propagules present 6

2. Upper cortex UV+ yellow, lichexanthone present.........................***H. novella***
2. Upper cortex UV- , lichexanthone absent 3

3. Medulla K+ red, salazinic acid present....................................***H. asiatica***
3. Medulla K-, salazinic acid absent...4

4. Medulla P+ red, protocetraric acid present..................................***H. adducta***
4. Medulla P-..5

5. Medulla KC-, fatty acids present...***H. flexilis***
5. Medulla KC+ orange, barbatic acid present...........................***H. physcioides***

6. Pustules or soredia present..7
6. Isidia and/or lobules present...15

7. Thallus yellow-green, usnic acid present...................................***H. sinuosa***
7. Thallus grey to greenish-grey, usnic acid absent......................................8

8. Soralia capitate, pustules absent 9
8. Soredia pustulate 11

9. Medulla K+ yellow or red, stictic or norstictic acid present..................................10
9. Medulla K- or K+ dull yellow-brown, protocetraric acid present.................
....***H. pseudosinuosa***

10. Medulla K+ yellow then red, norstictic acid present.....................***H. granulans***
10. Medulla K+ persistent yellow, stictic acid present....................***H. neostictifera***

11. Upper cortex UV+ yellow, lichexathone present...........................***H. osseoalba***
11. Upper cortex UV-, lichexathone absent 12

12. Medulla P+ red, protocetraric acid present ....***H. croceopustulata***
12. Medulla P-, protocetraric acid absent 13

13. Medulla C+ rose, KC+ red, gyrophoric acid present ....***H. revoluta***
13. Medulla C+ yellow or C-, KC+ orange, barbatic acid complex present...........14

14. Echinocarpic acid present...***H. adjuncta***
14. Echinocarpic acid absent ....***H. exsecta***

15. Isidia absent, lobules present...16
15. Isidia and ±lobules present 17

16. Margins ciliate, medulla C+ rose, gyrophoric acid present ....***H. ciliata***
16. Margins lacking cilia, medulla C-, barbatic acid present ....***H. physcioides***

17. Medulla P+ orange red, protocetraric acid present ....***H. koyaensis***
17. Medulla P-, protocetraric acid absent 18

18. Barbatic acid present (medulla KC+ orange) 19
18. Barbatic acid absent (medulla KC± rose)..20

19. Echinocarpic acid present ....***H. addita***
19. Echinocarpic acid absent ....***H. imbricatula***

20. Medulla C-, KC-, gyrophoric acid absent.......................................***H. ikomae***
20. Medulla C± pink, KC+ rose, gyrophoric acid present.....................***H. nodakensis***

THE SPECIES

1. Hypotrachyna addita (Hale) Hale, *Phytologia* **28**: 340 (1974)
≡ *Parmelia addita* Hale, *Phytologia* **22**: 433 (1972).

This species is characterized by the simple isidia and by the presence of 4-*O*-demethylbarbatic, barbatic and echinocarpic acids in the medulla (K-, C-, KC+ orange, P-). Morphologically *H. addita* resembles *H. imbricatula*, but can be distinguished from the latter by the smaller, less robust thallus, the lack of distinct maculae on the upper surface, the absence of obtusatic acid and the presence of echinocarpic acid in the medulla. Although Kurokawa (1986) synonymized *H. addita* with *H. imbricatula*, we concur with Hale (1972), Depriest & B. Hale (1999) and Louwhoff & Elix (2002), and maintain *H. addita* as a separate species.

Hypotrachyna addita is an east Asian species reported from the Philippines, Malaysia (Hale 1972), Australia (Elix 2001) and Papua New Guinea (Kashiwadani 1975; Kurokawa 1979; Louwhoff & Elix 2002). New to China.

Specimen examined

CHINA. **Guangxi**, Wuming, *J.B. Chen et al. 20382-1.*

2. Hypotrachyna adducta (Nyl.) Hale, *Phytologia* **28**: 340 (1974)
≡ *Parmelia adducta* Nyl., *Flora* **68**: 610 (1885).

Hypotrachyna adducta is characterized by the lack of vegetative propagules, the abundance of apothecia, the large ascospores (10-17 × 16-25 μm) and the presence of protocetraric acid in the medulla (P+ orange-red). This species closely resembles *H. keitauensis* (Asahina) Hale as both have broad lobes with subrotund apices, lack asexual propagules and produce protocetraric acid in the medulla. However, *H. keitauensis* differs by producing additional fatty acids.

Hypotrachyna adducta is a common Asian species which extends from India to Japan and Papua New Guinea (Kurokawa & Lai 2001; Louwhoff & Elix 2002). This species has been reported from China's mainland by Asahina (1951, 1952), Zhao (1964) and Zhao *et al.* (1982).

Representative specimens examined

CHINA. **Guizhou,** Daozhen, *Wu 2959.* **Yunnan,** Gongshan, *J.J. Su 2733, 3408;* Ximeng, *Y. L. Guo 242-2.*

3. Hypotrachyna adjuncta (Hale) Hale, *Phytologia* **28**: 340 (1974)
≡ *Parmelia adjuncta* Hale, *Phytologia* **22**: 434 (1972).

This species is characterized by the sublinear to subirregular lobes, the erumpent pustules which often becoming coarsely sorediate and the presence of the barbatic acid complex and echinocarpic acid in the medulla (K-, C+ orange, KC+ orange, P-). *Hypotrachyna adjuncta* is closely related to *H. exsecta*, but differs from the latter by the presence of echinocarpic acid. Kurokawa (1986) synonymised *H. adjuncta* with *H. exsecta* as he believed that the presence of echinocarpic acid in the medulla was not correlated with morphology or distribution. However, we agree with Hale (1974) and DePriest & B. Hale (1999) and maintain *H. adjuncta* as a separate species given that echinocarpic acid is biosynthetically unrelated to either barbatic or 4-*O*-demethylbarbatic acids (Elix 1982).

Hypotrachyna adjuncta is a tropical Asian species (Hale 1972; Pooprang *et al.* 1999), with a distribution which extends to Australia and Papua New Guinea (Elix 2001; Louwhoff & Elix 2002). It has been reported previously from Taiwan (Hale 1972). New to mainland China.

Representative specimens examined
CHINA. **Guangxi,** Lin'gui, *J.B. Chen et al. 20117;* Longshen, *J.B. Chen et al. 20018;* Wuming, *J.B. Chen et al. 20334.* **Hunan,** Yizhang, Mt Mangshan, *J.B. Chen et al. 20759;* Sangzhi, *J.B. Chen et al. 9579.* **Yunnan,** Ximeng, *Y.L. Guo 249.* **Zhejiang,** Longquan, *Z.G. Qian & C. Ding 6172.*

4. Hypotrachyna asiatica S.L. Wang, J.B. Chen & Elix, *Mycotaxon* **76**: 294 (2000). Type: CHINA. Yunnan, Mt Gongshan, 2200 m, on bark, *J. J. Su 2761* (holo: HMAS-L; iso: CANB).

This species is characterized by the narrow lobes (1.5-2.0 mm), the absence of vegetative propagules, the richly dichotomously branched rhizines and the presence of salazinic acid and zeorin in the medulla (K+ red, C-, KC-). Chemically *H. asiatica* is identical with *H. majoris* (Vain.) Hale, but the latter can be distinguished by the soredia and the sparsely branched, dichotomously rhizines. *Hypotrachyna asiatica* resembles *H. coorgian* Patwardhan & Prabhu in lacking vegetative propagules and containing salazinic acid, but *H. coorgiana* differs in having broader, involute lobes (2-3 mm cf. 1.5-2 mm wide) and sparse rhizines. *Hypotrachyna asiatica* is known only from the type locality and is endemic to China.

5. Hypotrachyna ciliata S.L. Wang, J.B. Chen & Elix, *Mycotaxon* **76**: 296 (2000). Type: CHINA. Yunnan, Mt Gongshan, 3000 m, on rocks, *J. J. Su 5013* (holo: HMAS-L; iso: CANB).

Hypotrachyna ciliata is characterized by the saxicolous substrate, lobes with blackened, ciliate margins, a maculate upper surface with laminal and marginal lobules, and the presence of gyrophoric acid in the medulla (C+ rose, KC+ red). Since the initial description of this species (Wang, Chen & Elix 2000), apothecia have been observed in several specimens: they are adnate to substipitate, to 6 mm wide; the disc concave, mid to dark brown with a smooth thalline exciple; ascospores ellipsoidal, 11-15 × 7-10 μm. *Hypotrachyna ciliata* is closely related to *H. scytophylla*, but the latter species lacks lobules, has smaller ascospores (8-9 × 5-6 μm cf. 11-15 × 7-10 μm), and grows on bark. At present this species is known only from China.

Specimens examined
CHINA. **Yunnan,** Mt Yulongshan, *X.Y. Wang et al. 4975;* Zhongdian, *X.Y. Wang et al. 5523.*

6. Hypotrachyna croceopustulata (Kurok.) Hale, *Smithsonian Contr. Bot.* **25**: 30 (1975)
≡ *Parmelia croceopustulata* Kurok., in Hale and Kurokawa, *Contr. U.S. Natl. Herb.* **36**: 169 (1964).

This species is characterized by the narrow, sublinear lobes, the off-white to yellow-brown medulla, the pustulate-sorediate upper surface and and the presence of protocetraric acid in the medulla (P+ orange red). *Hypotrachyna pseudosinuosa* also contains protocetraric acid, but this species has capitate soralia rather than the pustulate soredia observed in *H. croceopustulata.* This species is distinguished from other pustulate-sorediate species present in China by the presence of medullary protocetraric acid.

Previously this species was known from the southern United States, Mexico, throughout the Neotropics (Hale 1975; Nash *et al.* 2001) and in East Africa (Krog & Swinscow 1979), but is new to China.

Specimen examined

CHINA. **Hunan**, Yizhang, Mt Mangshan, *J. B. Chen et al. 20852.*

7. Hypotrachyna exsecta (Taylor) Hale, *Phytologia* **28**: 341 (1974)

≡ *Parmelia exsecta* Taylor, *London J. Bot*. **6**: 166 (1847).

= *Parmelia laevigata* (Sm.) Ach. f. *esorediata* Zahlbr., *Bot. Mag. Tokyo* **41**: 351 (1927).

= *Parmelia laevigata* subsp. *extremi-orientalis* Asahina, *J. Jap. Bot.* **26**: 289 (1951); *Hypotrachyna laevigata* subsp. *extremi-orientalis* (Asahina) Wang-Yang & Lai, *Taiwania* **21**: 227 (1976).

This species is distinguished by the pustules which erupt into granular soredia and by the presence of barbatic and 4-*O*-demethylbarbatic acids in the medulla. *Hypotrachyna exsecta* most closely resembles *H. adjuncta*, but the latter consistently produces minor amounts of echinocarpic acid in addition to the barbatic acid complex. *Hypotrachyna laevigata* (Sm.) Hale resembles *H. exsecta*, but the former can be separated by the presence of simple soralia with farinose soredia, the absence of pustules, and by the broader (2-5 *cf.* 1-3 mm wide), sublinear lobes rather than irregular lobes.

Hypotrachyna exsecta is widely distributed in tropical and subtropical regions of southeastern and eastern Asia and the southern Pacific, including Australia and Papua New Guinea (Elix 1994; Kurokawa 1979; Kurokawa & Lai 2001; Louwhoff & Elix 2002). In China this species has previously been recorded for Taiwan (Wang-Yang & Lai 1973; Kurokawa & Lai 2001). New to China's mainland.

Representative specimens examined

CHINA. **Fujian,** Mt Wuyishan, *J.B. Chen & S.L. Wang 14542.* **Guangxi,** Wuming, *J.B. Chen et al. 20343.* **Guizhou,** Mt Fanjingshan, *J.B. Chen 6372-1, 6416.* **Hunan,** Yizhang, Mt Mangshan, *J.B. Chen et al. 21029.* **Yunnan,** Xichou, *J.B. Chen 5241;* Wenli, *Y.M. Jiang 743-1.* **Zhejiang,** Longquan, *Z.G. Qian & C. Ding, 6095.*

8. Hypotrachyna flexilis (Kurok.) Hale, *Phytologia* **28**: 341 (1974)

≡ *Parmelia flexilis* Kurok., in Hara, *The Flora of Eastern Himalaya*: 607 (1966).

This species is characterized by the lack of vegetative propagules and the presence of myelochroic, isomyelochroic, 19-acetoxyprotolichesterinic and 19-acetoxylichesterinic acids in the medulla (K-, C-, KC-, P-). *Hypotrachyna flexilis* resembles both *H.*

adducta and *H. keitauensis*, with all three species having similar subirregular lobes with subrotund apices, lacking vegetative propagules and showing similar distribution patterns in south-eastern Asia (Kurokawa & Lai 2001). However, *H. adducta* and *H. keitauensis* produce protocetraric acid in the medulla (P+ orange-red) but this substance is absent in *H. flexilis*.
Hypotrachyna flexilis has been reported from India, Taiwan and Papua New Guinea (Kurokawa 1966; Kurokawa & Lai 2001). New to China's mainland.

Specimen examined
CHINA. **Yunnan,** Mt Ximengshan, *Y.L. Guo 242-5.*

9. Hypotrachyna granulans K.H. Moon, Kurok. & Kashiw., *Bull. Natn. Sci. Mus., Tokyo, ser. B,* **26**: 135 (2000).

This species is characterized by the subirregular lobes with subrotund apices, the capitate, marginal to submarginal soralia and the presence of norstictic acid (major), connorstictic acid (trace) and subnorstictic acid (trace) in the medulla (K+ yellow then red, P+ yellow). This species can readily be distinguished from other sorediate species of *Hypotrachyna* present in China by the presence of norstictic acid in the medulla. *Hypotrachyna granulans* was previously known only from Thailand (Moon *et al.* 2000). New to China.

Specimens examined
CHINA. **Guangxi,** Lingui, *J.B. Chen et al. 20261, 20291-2*. **Yunnan,** Mt Gongshan, *J.J. Su 2847*. **Zhejiang,** Taishun, *Z.G. Qian & C. Ding 6904.*

10. Hypotrachyna ikomae (Asahina) Hale, *Phytologia* **28**: 341 (1974)
≡ *Parmelia ikomae* Asahina, *J. Jap. Bot.* **28**: 134 (1953).

This species is characterized by the broad, subirregular lobes (2-7 mm wide) with subrotund apices, ±sparse cilia, mostly cylindrical to irregularly thickened isidia and by the presence of protolichesterinic, lichesterinic, nephrosterinic and isonephrosternic acids in the medulla (K-, C-, KC-, P-).
Hypotrachyna ikomae is known from Japan (Asahina 1953) and mainland China (Xu 1989).

Representative specimens examined
CHINA. **Guangxi,** Lingui, *J.B. Chen et al. 20291-1.* **Hainan,** Tongzha, *J.B. Chen et al. 20635.* **Yunnan,** Xichou, *J.B. Chen 527;* Xishuangbanna, *S.Y. Guo 94826.* **Zhejiang,** Taishun, *Z.G. Qian & C. Ding 6898, 5880.*

11. Hypotrachyna imbricatula (Zahlbr.) Hale, *Smithsonian Contr. Bot.* **25**: 41 (1975)
≡ *Parmelia imbricatula* Zahlbr., *Denkschr. Kaiserl. Akad. Wiss., Math.-Naturwiss. Kl.* **83**: 168 (1909).

Hypotrachyna imbricatula is characterized by the sublinear, commonly crowded, ±imbricate lobes, the presence of laminal maculae, isidia and ±lobules, and by the presence of barbatic, 4-*O*-demethybarbatic, obtusatic and norobtusatic acids in the medulla (K-, C-, KC+ orange, P-). This species strongly resembles both *H. addita* and *H. orientalis.* Indeed, Kurokawa (1979) and Kurokawa & Lai (2001) considered the latter two species to be synonyms of *H. imbricatula*. However, *H. addita* contains additional echinocarpic acid which is absent in both *H. imbricatula* and *H. orientalis.* In contrast to *H. imbricatula, H. orientalis* lacks obtusatic and norobtusatic acids in the medulla and has an emaculate upper surface.

Hypotrachyna imbricatula is a widely distributed subtropical-tropical species known from North, Central and South America (Hale 1975), Australia (Elix 1994), India (Awasthi 2000), Thailand (Wolseley *et al.* 2002), Taiwan (Kurokawa & Lai 2001), Philippines (Elix & Schumm 2001), Papua New Guinea (Kurokawa 1979; Louwhoff & Elix 2002) and the Hawaiian Islands (Smith 1993). New to China's mainland.

Specimen examined

CHINA. **Hainan**, Tongzha, *J.B. Chen et al. 20641.*

12. Hypotrachyna koyaensis (Asahina) Hale, *Smithsonian Contr. Bot.* **25**: 44 (1975)
≡ *Parmelia koyaensis* Asahina, *J. Jap. Bot.* **28**: 67 (1953).

This species is characterized by the subirregular, broad lobes (up to 8 mm wide) with subrotund apices, the laminal isidia and the presence of protocetraric acid in the medulla (K-, C-, KC+ pale pink, P+ orange-red).

Hypotrachyna koyaensis is known from Japan, South-East Asia, Mexico (Hale 1975), Papua New Guinea (Louwhoff & Elix 2002), and has been reported previously from Taiwan (Asahina 1959; Kurokawa & Lai 2001). New to mainland China.

Specimens examined

CHINA. **Guangxi,** Wuming, *J.B. Chen et al. 20366.* **Hainan**, Changjiang, *Y.M. Jiang & S.Y. Guo 414-1.* **Yunnan**, Xichou, *J.B. Chen 5189.* **Zhejiang,** Taishun, *Z.G. Qian & C. Ding 5629, 5592, 6731.*

13. Hypotrachyna neostictifera Elix, J.B. Chen & L. Xu, sp. nov. Fig. 1

Thallus ut in *Hypotrachyna stictifera* sed lobis angustatis et acidum menegazziaicum continente differt.

Type. CHINA. Yunnan. Ximeng, on twigs, *Y. L. Guo 242-4,* 2 August 1982 (holo: HMAS-L).

Thallus foliose, corticolous, loosely adnate to adnate, 3-4 cm wide. *Lobes* contiguous to imbricate, subirregular, irregularly branched, 1-3 mm wide, with entire to slightly crenate margins and subrotund apices. *Upper surface* grey to pale greenish grey, flat, ±cracked, slightly shiny, epruinose, emaculate, lacking isidia, pustules and lobules, sorediate; *soredia* farinose to granular, in subcapitate to labriform soralia. *Medulla* white. *Lower surface* black, pale brown to brown at apices; sparse to moderately rhizinate, rhizines simple to 1-3 times dichotomously branched. *Apothecia* and *pycnidia* not seen.

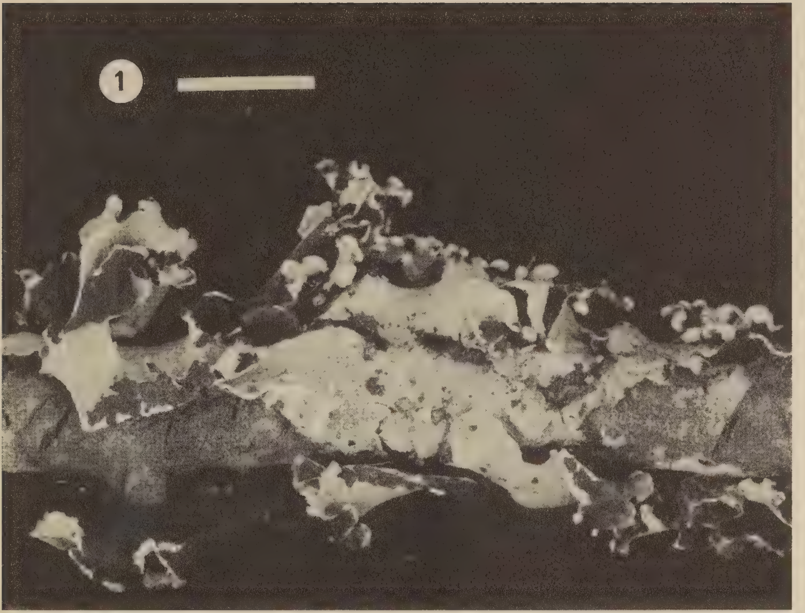

Figure 1. *Hypotrachyna neostictifera* (holotype in HMAS-L). Scale bar = 5 mm.

Chemistry. Cortex K+ yellow, C-, KC-, P-, UV-, medulla K+ yellow turning orange, C-, KC-, P+ orange-red; containing atranorin (major), chloroatranorin (minor), stictic acid (major), constictic acid (minor), norstictic acid (minor), menegazziaic acid (minor) and cryptostictic acid (trace).

This species is distinguished by the subirregular lobes with subrotund apices, the laminal, subcapitate to labriform soralia and the stictic acid chemosyndrome in the medulla. In overall morphology and medullary chemistry it closely resembles the South American species *H. stictifera* Kurok. & Moon, but the latter differs in having broader lobes (2-10 mm cf. 1-3 mm wide), elevated, capitate soralia (subcapitate to labriform in *H. neostictifera*) and a medulla which is orange-red in part due to the presence of skyrin (white in *H. neostictifera*). Further, menegazziaic acid is a prominent medullary component of *H. neostictifera* but is absent in *H. stictifera. Hypotrachyna neostictifera* also resembles *H. thryptica* (Kurok.) Hale in both morphology and chemistry. However, *H. thryptica* has crescent shaped to subglobose dactyls which burst open but do not become sorediate, rather than subcapitate to labriform soralia with farinose to granular soredia.

14. Hypotrachyna nodakensis (Asahina) Hale, *Phytologia* **28**: 341 (1974)
≡ *Parmelia nodakensis* Asahina, *J. Jap. Bot.* **34**: 226 (1959).

This species is characterized by the subirregular lobes (2-5 mm wide) with subrotund apices, the simple to coralloid-branched isidia, the absence of maculae and the presence of lichesterinic, protolichesterinic, nephrosterinic, isonephrosterinic and gyrophoric acids in the medulla (K-, C- or C+ pale pink, KC+ rose, P-). This species could be confused with two other isidiate species which contain fatty acids in the medulla: *H. infirma,* which contains caperatic and norcaperatic acids, and *H. ikomae,* which contains the same fatty acids as *H. nodakensis* but lacks gyrophoric acid. In addition, *H. ikomae* differs in having slightly inflated, barrel-shaped to markedly inflated or rarely squamiform isidia whereas *H. nodakensis* has simple to coralloid-branched, cylindrical isidia.

Hypotrachyna nodakensis is known from Japan (Asahina 1959) and mainland China (Xu 1989).

Representative specimens examined
CHINA. **Fujian,** Mt Wuyishan, *J.B. Chen & S.L. Wang 14096, 14471, 14706.* **Guizhou,** Mt Fanjingshan, *J.B. Chen 6384.* **Hunan,** Yizhang, Mt Mangshan, *J.B. Chen et al. 20863-3.* **Sichuan,** Mt E'meishan, *J.B. Chen 6168, Z.T. Zhao & Y.M. Jiang 8253-1.* **Zhejiang,** Longquan, *Z.Q. Qian & C. Ding 6506, 6512;* Taishun, *Z.G. Qian & C. Ding 6864.*

15. Hypotrachyna novella (Vain.) Hale, *Smithsonian Contr. Bot.* **25**: 49 (1975)
≡ *Parmelia novella* Vain., *Acta Soc. Fauna Fl. Fenn.* **7**: 56 (1890).

This species is characterized by the the presence of lichexanthone in the upper cortex (UV+ yellow), the lack of vegetative propagules and maculae, and the presence of lividic (major), colensoic and 4-*O*-methyphysodic acids in the medulla (K-, C+ rose or C-, KC+ rose, P-). Chemically this species is identical with *H. osseoalba* but the latter can be distinguished by the presence of laminal pustulate-soredia.

Hypotrachyna novella has been reported previously from South America (Hale 1975) and Australia (Elix 1994). New to China.

Specimens examined
CHINA. **Fujian**, Mt Wuyishan, *J.B. Chen & S.L. Wang 14143, 14600.* **Zhejiang,** Longquan, *Z.G. Qian & C. Ding 7052.*

16. Hypotrachyna osseoalba (Vain.)Y.S. Park & Hale, *Taxon* **38**: 88 (1989)
≡ *Parmelia osseoalba* Vain., *Ann. Soc. Zool. Bot. Fenn. Vanamo* **l**: 39 (1921).
= *Parmelia formosana* Zahlbr., *Repert. Spec. Nov. Regni Veg.* **33**: 57 (1934); *Hypotrachyna formosana* (Zahlbr.) Hale, *Smithsonian Contr. Bot.* **25**: 38 (1975).

This species is characterized by the laminal to submarginal pustulate soralia, the UV+ yellow upper cortex (lichexanthone) and the presence of the lividic acid complex in the medulla. The chemically identical *H. novella* can be considered to be the fertile counterpart of *H. osseoalba.*

Hypotrachyna osseoalba is widely distributed in subtropical and temperate regions of the world (Elix 1994; Hale 1975). In China this species has been reported by Asahina (1951, 1952), Kurokawa & Lai (2001), Xu (1989), Zhao (1964) and Zhao *et al.* (1982).

Representative specimens examined
CHINA. **Anhui,** Mt Huangshan, *J.D. Zhao & L.W. Xu 5212, 5258, 5474.* **Chongqing,** Mt Jinfoshan, *J.C. Wei & Z.T. Zhao c93.* **Fujian,** Mt Wuyi, *J.B. Chen & S.L. Wang 14060, 14701.* **Guangxi,** Longsheng, *J.B. Chen et al. 20100;* Wuming, *J.B. Chen et al. 20377.* **Hainan,** Changjiang, *Y.M. Guo & S.Y. Guo*; Ledong, *Y.M. Jiang & S.Y. Guo 550;* Mt Wuzhishan, *Y.M. Jiang & S.Y. Guo 1074.* **Hunan,** Yizhang, Mt Mangshan, *J.B. Chen et al. 20715;* Zhangjiajie, *J.B. Chen et al. 8964-1.* **Jiangxi,** Mt Lushan, *C. Ding 8229, 8282.* **Zhejiang,** Taishun, *Z.G. Qian & C. Ding 5732, 5798;* Longquan, *Z.G. Qian & C. Ding 6083, 7212.*

17. Hypotrachyna physcioides (Nyl.) Hale, *Smithsonian Contr. Bot.* **25**: 54 (1975)
≡ *Parmelia physcioides* Nyl., *Syn. Meth. Lich.* **1**: 385 (1860).

This very widely distributed species shows significant morphological and chemical variation. *Hypotrachyna physcioides* is characterized by the lack of vegetative propagules (or rarely the presence of sparse lobules) and the presence of the barbatic acid complex in the medulla. Hale (1975) reported that *H. physcioides* rarely develops sparse to dense, laciniate lobules and contains barbatic, 4-*O*-demethylbarbatic, obtusatic and norobtusatic acids in the medulla. He considered *Parmelia digitata* Lynge, a densely lobulate specimen from Brazil [which contains 4-*O*-demethylbarbatic acid (major)], to be an extreme form of *H. physcioides.* The type of *H. physcioides* on the other hand, lacks laciniate lobules and produces barbatic acid rather than 4-*O*-demethylbarbatic acid as the major medullary substance. It is possible that more than one taxon may have been included in this complex. One specimen from China is identical with the type of *H. physcioides* (i.e. it lacks lobules and contains barbatic acid (major) in the medulla). Three further specimens with similar chemistry produce sparse lobules, but are included in *H. physcioides* in the present paper.
Hypotrachyna physcioides is widely distributed in tropical America and South-East Asia (Hale 1975). New to China.

Representative specimens examined
CHINA. **Yunnan,** Mt Ximengshan, *Y.L. Guo 242-3;* Nongchuan, *X.Y. Wang et al. 3241;* Yingjiang, *X.Y. Wang et al. 3151*; Zhongdian, *X.Y. Wang et al. 5292, 5438.*

18. Hypotrachyna pseudosinuosa (Asahina) Hale, *Smithsonian Contr. Bot.* **25**: 58 (1975)
≡ *Parmelia pseudosinosa* Asahina, *J. Jap. Bot.* **26**: 329 (1951).

Hypotrachyna pseudosinuosa is characterized by the capitate, subterminal soralia and the presence of protocetraric acid in the medulla (K-, C-, KC-, P+ orange red).
This species is a widespread pantropical species reported from Central and South America, Japan, South-East Asia, South Africa (Hale 1975), Taiwan (Kurokawa & Lai 2001), the Hawaiian Islands (Smith 1993) and Papua New Guinea (Aptroot & Sipman 1991; Louwhoff & Elix 2002). In mainland China this species has been reported by Zhao (1964), Zhao *et al.* (1982) and Xu (1989).

Representative specimens examined
CHINA. **Fujian**, Mt Wuyishan, *J.B. Chen & S.L. Wang 14141, 14475.* **Guangxi**, Wuming, *J.B. Chen et al. 20383.* **Hainan**, Ledong, *J.B. Chen et al. 20779.* **Hunan**, Yizhang, Mt Mangshan, *J.B. Chen et al. 20941-2, 20982-1.* **Yunnan**, Simao, *J.D. Zhao & Y.B. Chen 2566;* Xichou, *J.B. Chen et al. 8594, J.B. Chen 5021.* **Zhejiang**, Longquan, *Z.G. Qian & C. Ding 6182, 6068;* Taishun, *Z.G. Qian & C. Ding 6813-2.*

19. Hypotrachyna revoluta (Flörke**)** Hale, *Smithsonian Contr. Bot.* **25**: 60 (1975)
≡ *Parmelia revoluta* Flörke, *Deutsche Lichenen* **1**: 11 (1815).

This species is characterized by the relatively loosely adnate thallus with sorediate, often revolute lobes, sparsely branched rhizines, and the presence of gyrophoric and 5-*O*-methylhiascic acids in the medulla (K-, C+ rose, KC+ red, P-).
Hypotrachyna revoluta is widely distributed in temperate to montane-pantropical areas of the world (Hale 1975; Louwhoff & Elix 2002). Although this species has been reported by Jatta (1902) (see Wei 1991), Zahlbruckner (1930), Zhao (1964) and Zhao *et al.* (1982) as occurring in mainland China, it appears to be very rare. Only one specimen has been examined in the present study.

Specimen examined
CHINA. **Zhejiang**, Longquan, *Z.G. Qian & C. Ding 6461.*

20. Hypotrachyna sinuosa (Sm.) Hale, *Smithsonian Contr. Bot.* **25**: 63 (1975)
≡ *Lichen sinuosa* Sm., *Eng. Bot.* **29**: 2050 (1809); *Parmelia sinuosa* (Sm.) Ach., *Syn. Meth. Lich.*: 207 (1814).

This species is characterized by the yellow-green upper surface (K-, usnic acid present), the narrow lobes (1.0-2.5mm wide), the terminal, capitate soralia, and the presence of salazinic and norstictic acids in the medulla (K+ yellow turning deep red, C-, P+ orange).
Hypotrachyna sinuosa is known from all continents except Antarctica, from the Pacific and Papua New Guinea (Louwhoff & Elix 2002). In China's mainland this species has been reported by Zhao (1964), Wei & Chen (1974), Zhao *et al.* (1982), Wei & Jiang (1986), Chen *et al.* (1989).

Representative specimens examined
CHINA. **Hubei**, Mt Shennongjia, *J.B. Chen 10663, 11308.* **Sichuan**, Mt E'meishan, *J.B. Chen 6187, 6202, 6262; Y. Wang 9513.* **Yunnan**, Mt Yulongshan, *Ahti et al. 46426;* Zhongdian, *X.Y. Wang et al. 5290, 5797.*

SUMMARY

In the present paper we have detailed the occurrence of 20 species of *Hypotrachyna* in mainland China. Previously, Kurokawa & Lai (2001) have reported 20 species of this genus from China's Taiwan, of which 10 species are common to both regions. Thus a total of 30 species of *Hypotrachyna* are recognized in China as summarized in Table 1.

Table 1. Species of *Hypotrachyna* in China

Species	Mainland China	Taiwan (Kurokawa & Lai 2001)
H. addita (Hale) Hale	+	-
H. adducta (Nyl.) Hale	+	+
H. adjuncta (Hale) Hale	+	+#
H. asiatica Wang, Chen & Elix	+	-
H. ciliata Wang, Chen & Elix	+	-
H. consimilis (Vain.) Hale	-	+
H. crenata (Kurok.) Hale	-	+
H. croceopustulata (Kurok.) Hale	+	-
H. endochlora (Leight.) Hale	-	+
H. exsecta (Taylor) Hale	+	+
H. exsplendens (Hale) Hale	-	+
H. flexilis (Kurok.) Hale	+	+
H. granulans Moon, Kurok. & Kashiw.	+	-
H. ikomae (Asahina) Hale	+	-
H. imbricatula (Zahlbr.) Hale	+	+
H. immaculata (Kurok.) Hale	-	+
H. infirma (Kurok.) Hale	-	+
H. keitauensis (Asahina) Hale	-	+
H. kingii (Hale) Hale	-	+
H. koyaensis(Asahina) Hale	+	+
H. majoris (Vain.) Hale	-	+
H. neostictifera Elix, Chen & Xu	+	-
H. nodakensis (Asahina) Hale	+	-
H. novella (Vain.) Hale	+	-
H. osseoalba (Vain.) Y.S. Park & Hale	+	+
H. physcioides (Nyl.) Hale	+	-
H. pseudosinuosa (Asahina) Hale	+	+
H. revoluta (Flörke) Hale	+	+
H. sinuosa (Sm.) Hale	+	+
H. sublaevigata (Nyl.) Hale	-	+
Total 30	20	20

# Kurokawa (1986) and Kurokawa & Lai (2001) treated *H. adjuncta* as a synonym of *H. exsecta*.

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A NEW SPECIES OF LACHNUM ON LEAVES OF LIVISTONA AND A KEY TO THE CHINESE SPECIES OF THE GENUS*

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Abstract: *Lachnum pseudocorreae* on leaves of *Livistona* sp. is described as a new species characterized by combination of the medium sized apothecia, short hairs, extremely short asci, lanceolate paraphyses, small ascospores, and occurrence on leaves of *Livistona*. A key to 48 species and 4 varieties of *Lachnum* known from China is provided.

Key words: *Lachnum pseudocorreae*, taxonomy

Lachnum Retz. 1769 is a fairly large genus of the Hyaloscyphaceae with around 170 species recognized (Kirk et al., 2001). Members of the genus occur on a wide range of plants (dicotyledons, monocotyledons, conifers, and ferns) as saprophytes. They are commonly found on rotten wood, bark, twigs, herbaceous stems, leaves, rachises, fronds, floral axes, etc., and in lowland to high elevations. The genus is characterized by the subsessile to long-stipitate apothecia with excipular hairs covered by evenly distributed granules on the surface, rectangular cells in the ectal excipulum, and lanceolate to narrowly lanceolate paraphyses (Nannfeldt, 1932). Due to various taxonomic opinions in the past and change of the starting point in the International Code of Botanical Nomenclature (Sydney) (Voss et al., 1983), ca. 20 synonyms appeared, such as *Trichopezizella* Dennis, *Brunnipula* Baral & Krieglst., and *Capitotricha* (Raitv.) Baral & Krieglst. (Eriksson & Hawksworth, 1998; Kirk et al., 2001). Names having been applied to species of *Lachnum* in China are *Dasyscyphus* Gray, *Dasyscypha* Fuckel, *Erinella* Sacc., *Erinellina* Seaver, and *Lachnum* (Teng 1963; Tai, 1979).

Species diversity of *Lachnum* in some regions of the world has been investigated, such as the United Kingdom (Dennis, 1949, 1978), Australasia (Dennis, 1961; Spooner, 1987), North and South America (Dennis 1954, 1960; Haines, 1980; Haines & Dumont, 1984; Haines, 1992), India (Haines et al., 1980; Sharma, 1986), and China (Korf & Zhuang, 1985; Zhuang, 1989, 1998, 2000; Wu et al., 1998; Yu & Zhuang, 2002; Ye & Zhuang, 2003). Studies of *Lachnum* in China date back to the 1920's

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when Keissler (1924) published *L. foliicola* Keissl. on leaves of *Rhododendron* sp. from Yunnan. Later, Teng (1934) recorded *L. abnorme* (Mont.) J.H. Haines & Dumont (as *Erinella sinensis* Teng) and *L. virgineum* (Batsch) P. Karst. Soon after, the Chinese records of the genus increased to 4 species which were mostly found in southern China (Teng, 1939). Up to the 1980's 7 species (excluding their synonyms) were known (Liou & Chen, 1977; Tai, 1979). In the past two decades, the known species raised dramatically to 48 species and 4 varieties, which reveals the high diversity of the genus in China.

More than 200 years have passed since the establishment of the genus *Lachnum*. Although mycologists agree, in general, on the generic concept as well as on delimitation of species within the genus, many questions remain unsolved. There are quite a number of species having small, unicellular ascospores (less than 10 µm in length) and occurring on a wide range of plants. In this case, apothecial gross morphology and type of substrate may become critical in identification of these species; others, like *L. virgineum*, are not substrate-specific. In other cases, collections of the same species are usually uniform in anatomical structure, whereas, sizes of apothecia, asci, and ascospores may vary slightly with types of plant tissues on which fruitbodies occur, such as leaves, petioles, small twigs, large branches, etc. Very few attempts to define the generic concept of *Lachnum* are reported. Preliminary studies by DNA sequencing revealed that the genus may not be monophyletic (Cantrell & Hanlin, 1997; Yu & Zhuang, 2003). Further work is needed to establish a suitable circumscription of the genus. The generic concept accepted in this paper follows the majority of authors and is in a relatively broad sense (Dennis, 1978; Haines & Dumont, 1984; Spooner, 1987; Hansen & Knudsen, 2000).

A NEW SPECIES OF *LACHNUM* ON *LIVISTONA*

Lachnum pseudocorreae W.Y. Zhuang & Z.H. Yu, sp. nov. (Figs. 1-4)

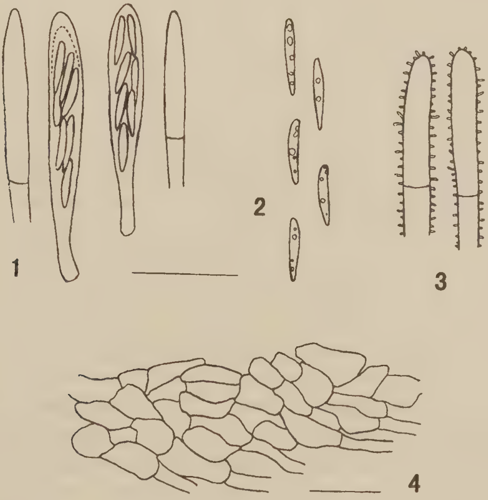
Ab *Lachno correae* differt apotheciis grandis, 0.5—1.3 mm diam; pilis parvis, 15—35(—45) × 2—3.8 µm; ascis angustis, 23—29 × 2.8—3.5 µm; ascosporis angustis 6—7 × 0.8—1 µm.

Apothecia solitary, discoid, 0.5—1.3 mm diam, stipitate; hymenium surface light yellow to cream when fresh becoming pale yellow when dry, receptacle surface white, covered with white hairs. Hairs subcylindrical, straight, with 1—2(—3) septa, granulate, thin-walled, subhyaline, 15—35(—45) × 2—3.8 µm excluding the markings. Ectal excipulum of textura prismatica, 15-30 µm thick; cells hyaline, walls slightly refractive, 7—15 × 2.5—5(—6) µm. Medullary excipulum of textura intricata, 10—70 µm thick; hyphae hyaline, 1.5—3 µm wide. Subhymenium 7—10 µm thick. Hymenium 32—36 µm thick. Asci cylindric-clavate, arising from croziers, 8-spored, pore walls blue in Melzer’s reagent, 23—29 × 2.8—3.5 µm. Ascospores subfusoid to clavate, hyaline, unicellular, guttulate, irregularly biseriate, 6—7 × 0.8—1 µm. Paraphyses narrowly lanceolate, 1.8—2.5 µm wide at the widest, exceeding the asci by 0—5 µm.

Holotype: on leaves of *Livistona ?chinensis* Mart., Jianfengling, Ledong, Hainan, alt. 1000 m, 10-XII-2000, Z.H. Yu, W.Y. Zhuang & Y.H. Zhang 3774, HMAS 76728.

Paratypes: on leaves of *Livistona ?chinensis* Mart. associated with *Lachnum palmae* (Kanouse) Spooner, Jianfengling, Ledong, Hainan alt. 1000 m, 9-XII-2000, W.Y. Zhuang, Y.H. Zhang & Z.H. Yu 3722, HMAS 76729; on leaves of *Livistona ?chinensis* Mart., Bawangling, Changjiang, Hainan, alt. 1115 m, 7-XII-2000, Y.H. Zhang, Z.H. Yu & W.Y. Zhuang & 3694, HMAS 81578.

Notes: *Lachnum pseudocorreae* is similar to *L. albopileatum* (Cooke) M.P. Sharma from India and the United States in length of hairs and size of ascospores, but differs in shorter asci (23—29 × 2.8—3.5 µm *vs.* 28—43 × 3—4.5 µm), narrower paraphyses (1.8—2.5 µm *vs.* 4 µm wide) which do not obviously exceed the asci (by 0—5 µm *vs.* 20 µm), ascospores with a few small guttules instead of non-guttulate, and occurrence on leaves of *Livistona* sp. instead of *Magnolia* sp. (Dennis, 1963; Haines et al., 1980). It is also similar to *L. correae* Spooner from Australia in length of asci, and shape of paraphyses but is distinguished from the latter in much larger apothecia (0.5—1.3 mm *vs.* 0.25—0.4 mm diam.), lack of crystals on hair surface, narrower ascospores [ca. 6—7 × 0.8—1 µm *vs.* (4.5—)5—6.5 × ca. 1.5 µm], narrower asci [23—29 × 2.8—3.5 µm *vs.* 22—28(—30) × 3.5—4.5 µm], and occurrence on leaves of *Livistona* sp. instead of on petioles of *Correa reflexa* (Labill.) Vent. (Rutaceae). *Lachnum acerinum* (Cooke & Ellis) Cash from the United States on leaves of *Acer* sp. is also similar to the new species in possessing small ascospores and short hairs but differs in the sessile and much smaller (0.2 mm in diam) apothecia, much wider asci (30—35 × 6 µm *vs.* 23—29 × 2.8—3.5 µm), and the brown hairs.



Figs. 1—4. *Lachnum pseudocorreae*: 1. Asci with ascospores and paraphysis apices; 2. Free ascospores; 3. Hair apices; 4. Ectal excipular structure at flank. Scale bars = 10 µm. All from HMAS 76729.

Lachnum pseudocorreae is characterized by the combination of short hairs, small asci and ascospores, medium-sized and light-colored apothecia, and occurrence on leaves of *Livistona*; and is clearly distinguishable from any other species of *Lachnum* on palms (Dennis, 1963; Sharma, 1986; Spooner, 1987; Cantrell & Haines, 1997; Yu & Zhuang, 2002).

A KEY TO THE KNOWN SPECIES OF *LACHNUM* IN CHINA

1. Upper one or two cells of paraphyses granulate .... ***L. granulatum*** W.Y. Zhuang, Yanna & K.D. Hyde
1. Paraphyses smooth-walled 2
    2. Ascospores lunate; on pine needles .... ***L. lutanum*** W.Y. Zhuang & Spooner
    2. Ascospores other shapes; not on pine needles 3
3. Ascospores unicellular, occasionally a very few spores with one septum 4
3. Ascospores with one or more than one septum........ 38
    4. Apothecia long-stipitate, stipe up to 4—14 mm long; on fallen seeds, roots or plant debris barely covered by soil 5
    4. Stipes of apothecia less than 4 mm long 6
5. Apothecia commonly on roots; ascospores (5—)6—9 × 1.5—2 μm .... ***L. pygmaeum*** (Fr.) Bres.
5. Apothecia on fallen seeds; ascospores 5—7.5 × 1.9—2.7 μm .... ***L. tengii*** W.Y. Zhuang
    6. Ascospores subcylindrical or aciculate, rounded at both ends, or with upper end rounded and the lower one slightly narrowed........ 7
    6. Ascospores subellipsoid to subfusoid, either rounded or acute at ends 13
7. Ascospores acicular, pointed at both ends 8
7. Ascospores long-cylindrical, with rounded ends 11
    8. On wood; ascospores 28—42 × 2 μm .... ***L. javanicum*** (Henn. & E. Nyman) J.H. Haines, Korf & W.Y. Zhuang
    8. On leaves 9
9. Ascospores (32—)35—38(—41) × 0.8—1.3 μm; hair apices covered with deep red amorphous substances........ ***L. fushanense*** M.L. Wu & J.H. Haines
9. Ascospores 21—52 × 0.5—1 μm; hair apices lack of amorphous substances .... ***L. mapirianum*** (Pat. & Gaillard) M.P. Sharma 10
    10. Ascospores 40—52 × 0.6—1 μm; asci 53—72 × 4.8—5.5 μm .... ***L. marpirianum*** var. ***mapirianum***
    10. Ascospores 21—35 × 0.5—0.8 μm; asci 36—49 × 4—5 μm .... ***L. marpirianum*** var. ***sinense*** Z.H. Yu & W.Y. Zhuang
11. Ascospores (39—)50—88(—98) × 1—1.8 μm .... ***L. palmae*** (Kanouse) Spooner
11. Ascospores 32—56 × 1.5—2 μm .... ***L. pritzelianum*** (Henn.) Spooner 12
    12. Hairs 30—90(—120) μm long, apices not covered with amorphous substances .... ***L. pritzelianum*** var. ***pritzelianum***
    12. Hairs 80—220(—300) μm long, apices covered with amorphous substances .... ***L. pritzelianum*** var. ***longipilosum*** Z.H. Yu & W.Y. Zhuang
13. Ascospores mostly equal to or less than 10 μm long........ 14

13. Ascospores mostly longer than 10 μm 28

14. Hymenium surface white when fresh, purplish brown when dry; ascospores 7—9 × 1.8—2.2 μm .... ***L. pudibundum*** (Quél.) J. Schröt.

14. Hymenium surface not becoming purplish brown when dry 15

15. Ascospores subellipsoid, up to 2.5 μm wide 16

15. Ascospores fusiform to fusoid-clavate, less than 2 μm wide 17

16. On dicotyledons; ascospores 5—8 × 1.5—2.5 μm, with 2(-4) small guttules .... ***L. brevipilosum*** Baral & Krieglst.

16. On ferns; ascospores 6-10 × 1.5-2.5, with 2 large guttules .... ***L. singerianum*** (Dennis) W.Y. Zhuang & Z. Wang

17. Hairs or excipular surface brown 18

17. Neither hairs nor excipular surface brown 20

18. On twigs; asci 56—58 × 3.5—4 μm; ascospores fusoid to clavate, 6—9 × 1.5—2 μm .... ***L. calyculiforme*** (Schumach.) P. Karst.

18. On leaves 19

19. Asci 42—45 × 3.5—4 μm; ascospores cylindric-clavate to rod-shaped, 6.5—9 × 1.3-1.5 μm; excipular surface grayish white, covered with dark brown hairs .... ***L. willisii*** (G.W. Beaton) Spooner

19. Asci 40—47 × 5 μm; ascospores cylindric-clavate, 7—8 × 1.5 μm; excipular surface brown, covered with white hairs .... ***L. foliicola*** Keissl.

20. On ferns; ascospores fusoid, with two ends slightly asymmetrical .... ***L. flavidulum*** (Rehm) J.H. Haines

20. On other plants 21

21. On leaves 22

21. On other plant tissues 23

22. On leaves of *Livistona*; asci 23—29 × 2.8—3.5 μm; paraphyses exceeding the asci by 0—5 μm .... ***L. pseudocorreae*** W.Y. Zhuang & Z.H. Yu

22. On leaves of *Miscanthus* and some dicotyledons; asci 31—40 × 3.2—4.5 μm; paraphyses exceeding the asci by 8—20 μm .... ***L. carneolum*** (Sacc.) Rehm

23. Lignicolous, occasionally on leaves of monocotyledon, pine cones or ferns; apothecia white; hairs usually swollen at apex; ascospores with 2 small polar guttules .... ***L. virgineum*** (Batsch) P. Karst.

23. On stems of monocotyledons or herbaceous stems.......... 24

24. On herbaceous stems 25

24. On stems of monocotyledons 26

25. On *Polygonum,*stems; ascospores 4.8—6.4(—9) × 1—1.4(—1.9) μm; hairs not swollen at apex, 20—100 μm long .... ***L. taiwanense*** J.H. Haines, M.L. Wu & Y.Z. Wang

25. On other herbaceous stems .... ***L. nudipes*** (Fuckel) Nannf.

26. Paraphyses narrowly lanceolate, 1.5—2 μm at the widest .... ***L.*** cf. ***salicariae*** (Rehm) Raitv.

26. Paraphyses lanceolate, 3—5 μm at the widest 27

27. Commonly on *Phragmites* and other monocotyledons, rarely on stems of dicotyledons; apothecia 0.3—1.5 mm diam; hairs 20—100 μm long .... ***L. controversum*** (Cooke) Rehm

27. On stems of small grasses; apothecia less than 0.5 μm diam; hairs 10—65 μm long

.... ***L. tenuissimum*** (Quél.) Korf & W.Y. Zhuang

28. On bamboo or ferns 29

28. On other plants 32

29. On bamboo .... ***L.*** cf. ***stipulicola*** J.H. Haines

29. On ferns 30

30. Ascospores symmetrical, blunt at ends, 8—15 × 1.2—1.8(—2) µm .... ***L. pteridophyllum*** (Rodway) Spooner

30. Ascospores pointed at ends, longer than 15 µm 31

31. Ascospores 17—28 × 1.8—2.5 µm .... ***L. lanariceps*** (Cooke & W. Phillips) Spooner

31. Ascospores (24—)27—39(—42) × 2—3.2 µm .... ***L. oncospermatis*** (Cooke) Rehm

32. Hymenium surface pink to red, receptacle surface white to cream, ascospores 16—23 × 1.5—2 µm .... ***L. bannanënse*** Z.H. Yu & W.Y. Zhuang

32. Hymenium lacking red pigmentation 33

33. Hairs covered by reddish resinous substance .... ***L. lushanense*** W.Y. Zhuang & Z. Wang

33. Hairs not covered by reddish resinous substance 34

34. On palms; ascospores long-clavate to cylindrical, 12.5—20 × 1.8—2.7 µm .... ***L. privum*** Z.H. Yu & W.Y. Zhuang

34. On other plants 35

35. On rotten wood and twigs; ascospores long-ellipsoid, with 2—4 guttules .... ***L. subpygmaeum*** W.Y. Zhuang

35. On leaves; ascospores of other shapes.. 36

36. Ectal excipulum of highly refractive and short cells; ascospores fusoid, 15—21 ×2—3 µm .... ***L. ciliare*** (Schrad.) Rehm

36. Ectal excipulum not consisting of short cells; ascospores smaller 37

37. Apothecia 0.2-0.7 mm diam; hairs subhyaline to light yellow, 40—76 × 2.5—3.5 µm; ascospores fusoid, with many guttules .... ***L. hainanense*** W.Y. Zhuang & Z. Wang

37. Apothecia 1.2—1.8 mm diam; hairs hyaline, 100—169 × 4.9—7.8 µm; ascospores elogate-fusoid, non-guttulate .... ***L. albidulum*** (Penz. & Sacc.) M.P. Sharma

38. Ascospores with 0—1 septum or uniseptate, fusoid to elongate-fusoid 39

38. Ascospores with more than 1 septum 42

39. On stems of monocotyledons, ascospores (10—)14—19.5 × (2—)2.5—3(—3.5) µm cylindric-subfusoid with rounded ends .... ***L. motanum*** W.Y. Zhuang & M.Ye

39. On dicotyledons 40

40. On stems of *Rubus*; hairs thick-walled; paraphyses deformed apically, sometimes branched; ascospores fusoid, 1-septate, 11.5—15.5(—17.8) × 2.5—3 µm......................... ***L. scabrovillosum*** (W. Phillips) J.H. Haines & M.P. Sharma

40. On barks and twigs 41

41. Asci 88—118 × 6.5—9.5 µm; ascospores long-fusoid, (20—)30—52 × (1.4—)1.8—2.5 µm .... ***L. brasiliense*** (Mont.) J.H. Haines & Dumont

41. Asci 88—110 × (4.2—)5—5.5(—6) µm; ascospores subfusoid with rounded ends, (9—)12—18(—22.5) × (1.5—)2—2.6(—3) µm .... ***L. angustum*** W.Y. Zhuang & M. Ye

42. Ascospores with 1—3 septa 43

42. Ascospores with more than 3 septa 47

43. Lignicolous; ascospores fusoid, usually with 3 septa

.... *L.* ***sclerotii*** (A.L. Sm.) J.H. Haines & Dumnot 44

43. On monocotyledons 45

44. Ectal excipular cells not refractive; ascospores (16—)21—35(—47) × 1.8—2.8 (—3) µm; ascus base simple ....*L.* ***sclerotii*** var. ***sclerotii***

44. Ectal excipular cells strongly refractive; ascospores 18—36 × 2.6—4 µm; ascus base bifurcate .... *L.* ***sclerotii*** var. ***sichuanense*** W.Y. Zhuang & M. Ye

45. On leaf sheaths of graminaceous plants; ascospores subfusoid to subclavate, with 0—3 septa, (19—)25—32(—38) × 3—3.5(—4) µm *L.* ***minutum*** W.Y. Zhuang & M. Ye

45. On culms of bamboo 46

46. Ascospores subcylindrical, with blunt ends, with 3 septa, 44—58 × 2—3 µm .... *L.* ***cylindricum*** W.Y. Zhuang & K.D. Hyde

46. Ascospores fusiform, with pointed ends, with 1—3 septa, 20—31 × 2.5—3 µm .... *L.* ***pseudosclerotii*** Z.H. Yu & W.Y. Zhuang

47. Ascospores subcylindrical, with 7—14 septa .... *L.* ***calosporum*** (Pat. & Gaillard) J.H. Haines & Dumont

47. Ascospores with fewer than 10 septa 48

48. Lignicolous 49

48. On other substrates 51

49. Ascospores clavate, with 7 septa at maturity, wider than 2.2 µm .... *L.* ***attenuatum*** J.H. Haines & Dumnot

49. Ascospores subcylindrical, with 7—9 septa at maturity, less than 2.2 µm wide .... *L.* ***abnorme*** (Mont.) J.H. Haines & Dumnot 50

50. Ascospores with 7 septa, 35—68(—72) × 1.5—2.2(—2.5) µm ... *L.* ***abnorme*** var. ***abnorme***

50. Ascospores with 7—9 septate, 53—59(—88) × 1.5—2 µm .... *L.* ***abnorme*** var. ***sinotropicum*** Z.H. Yu & W.Y. Zhuang

51. On *Miscanthus*, bamboo and herbaceous stems; ascospores subcylindrical, with 3—5 septa, (31—)37—59(—64) × 1.4—2 µm .... *L.* ***hyalopus*** (Cooke & Massee) Spooner

51.On culms of bamboo; ascospores with 7 or more than 7 septa .... *L.* ***kumaonicum*** (M.P. Sharma) M.P. Sharma

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NEW SPECIES AND NEW RECORDS IN THE LICHEN FAMILY PARMELIACEAE (ASCOMYCOTA) FROM MACARONESIA

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ABSTRACT: *Neofuscelia canariensis* and *N. stenosporonica* from the Canary Islands and *Xanthoparmelia madeirensis* from Madeira are described as new to science. In addition, three species of Parmeliaceae are reported for the first time from Madeira.

KEY WORDS: *Neofuscelia canariensis, Neofuscelia stenosporonica, Xanthoparmelia madeirensis,* new records

The lichens of the Laurimacaronesian archipeligo (Azores, Madeira, Canary Islands) have been well studied and a checklist and bibliography published (Hafellner 1992, 1995, 1999, 2002). Nevertheless, new species and new records continue to be discovered attesting to the rich biodiversity of these islands (Giralt *et al.* 2002; McCarthy & Etayo 2002; Sérusiaux *et al.* 2002). In the present paper we describe three new species in the family Parmeliaceae from these islands. Throughout the present work chemical constituents were identified by thin layer chromatography (Culberson 1972; Culberson & Johnson 1982; Elix & Ernst-Russell 1993), high performance liquid chromatography (Feige *et al.* 1993; Elix & Wardlaw 2000) and comparison with authentic samples.

Neofuscelia canariensis Elix & Schumm, sp. nov. Fig. 1

Thallus ut in *Neofuscelia glabrans* sed acidum stenosporonicum, acidum colensoicum et acidum divaronicum continente differt.

Type: CANARY ISLANDS. Gran Canaria: *ca.* 1.5 km S of La Culata, 27°58'N, 15°36'W, 1570 m, on gravelly soil on dry, rocky N-slope with scattered *Pinus canariensis, F. Schumm & U. Schwarz,* 25 Dec. 1998; holo: herb. Schumm 5165.

Thallus small-foliose or foliose, adnate to loosely adnate, terricolous or saxicolous, 1-4 cm wide. *Lobes* imbricate or not, ±flat, sublinear to irregular, 0.8-2.0 mm wide, lacking laciniae. *Upper surface* dark, chocolate-brown, dull in centre, shiny at lobe apices, ± smooth and flat, becoming fissured and cracked, without isidia. *Lower surface* ±smooth, black, dark brown at apices; rhizines sparse to moderate, simple, black. *Apothecia* and *pycnidia* not seen.

Chemistry. Cortex K-, HNO_3+ dark blue-green; medulla K-, C-, KC+ red, P-; containing stenosporonic acid (major), colensoic acid (minor), divaronic acid (minor), alectoronic acid (trace).

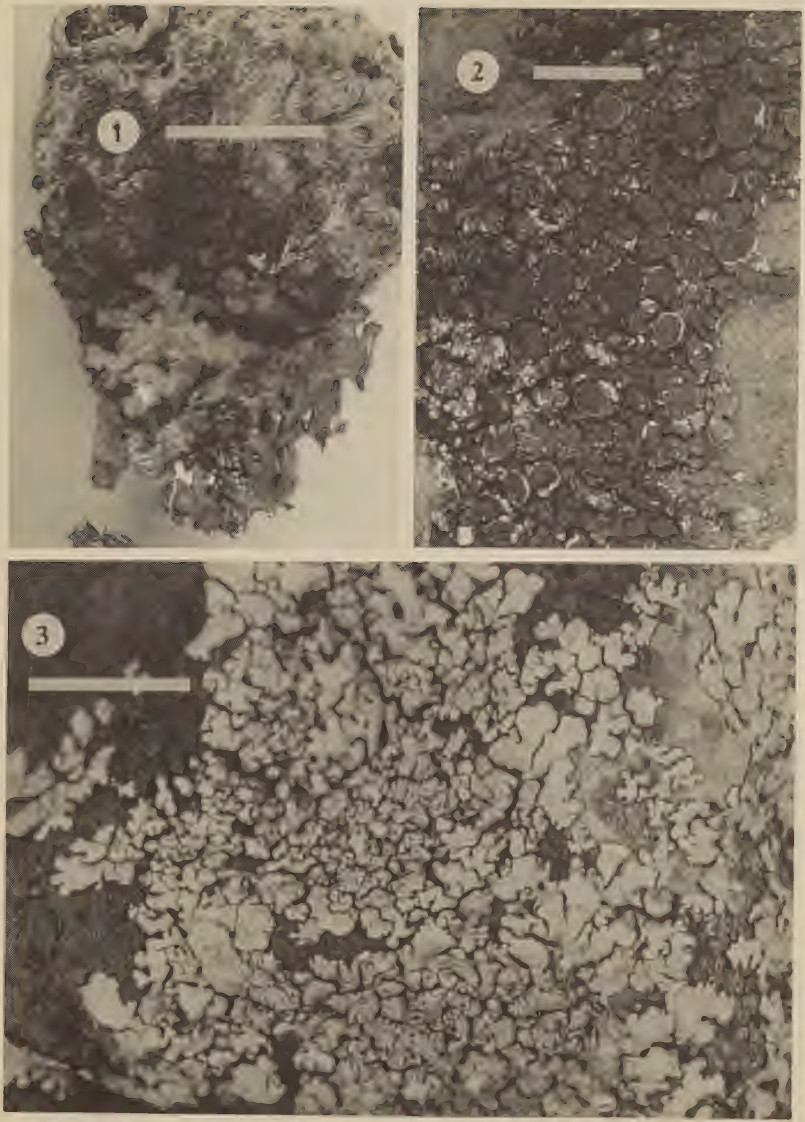
This species is characterized by the tightly adnate to adnate thallus, the black lower surface, the absence of isidia, and by the presence of stenosporonic, colensoic and divaronic acids in the medulla. *Neofuscelia canariensis* resembles the much more common and widely dispersed *N. glabrans* (Nyl.) Essl. as both lack isidia, have foliose thalli with a black lower surface and contain orcinol depsidones. However, *N. glabrans* differs in containing alectoronic and α-collatoloic acids (UV+ blue-white) rather than the stenosporonic acid chemosydrome. Stenosporonic acid has not previously been reported as occurring in *Neofuscelia* (but see following species). Both *N. glabrans* and *N. canariensis* can be considered to belong to the *N. pulla* (Ach.) Essl. group of species. At present this new species is only known from the type locality.

Neofuscelia stenosporonica Elix & Schumm, sp. nov. Fig. 2

Thallus ut in *Neofuscelia verisidiosa* sed acidum stenosporonicum, acidum colensoicum et acidum divaronicum continente differt.

Type: CANARY ISLANDS. Gran Canaria: road between Mogan and San Nicholas, 27°56'N, 15°45'W, 700 m, on rocks on dry, rocky NW-slope with *Echium-Euphorbia-Kleinia* community, *F. Schumm & U. Schwarz,* 30 Dec. 1999; holo: herb. Schumm 6678.

Thallus foliose, adnate, saxicolous, 3-4 cm wide. *Lobes* imbricate to contiguous, flat to weakly convex, subirregular to sublinear, 0.8-1.5 mm wide. *Upper surface* dark brown, shiny at the lobe apices, becoming dull and weakly rugulose on older parts of the thallus; isidia moderately dense to dense, subglobose to globose, becoming coralloid-branched; apices of isidia syncorticate to weakly epicorticate, shiny, intact or rarely bursting. *Medulla* white. *Lower surface* black, pale to dark brown at lobe apices; rhizines sparse to moderate, simple, black. *Apothecia* sessile, 1.0-2.5 mm wide; disc dark brown to black-brown, concave at first but becoming undulate-distorted and ultimately convex, margin smooth then ±densely isidiate. *Ascospores* ellipsoidal, 7-9 x 4.5-5.5 µm. *Pycnidia* rare, immersed. *Conidia* bifusiform, 7-8 x 1 µm.



Figures 1-3. New species of Parmeliaceae. 1. *Neofuscelia canariensis* (holotype in herb. Schumm); 2. *N. stenosporonica* (holotype in herb. Schumm); 3. *Xanthoparmelia madeirensis* (isotype in CANB). Scale bar = 5 mm.

Chemistry. Cortex K-, HNO_3+ blue-green, medulla K-, C-, KC+ red, P-; containing stenosporonic acid (major), colensoic acid (minor), divaronic acid (minor), alectoronic acid (trace).

In gross morphology *N. stenosporonica* resembles the more common *N. verisidiosa* (Essl.) Essl., with both species having adnate, foliose thalli with an isidiate upper surface and containing orcinol depsidones in the medulla. Chemically, *N. verisidiosa* differs in having alectoronic and α-collatoloic acids (UV+ blue-white) rather than the stenosporonic acid chemosydrome. *Neofuscelia verisidiosa* also differs in having somewhat broader lobes (1-3 mm cf. 0.8-1.5 mm wide), cylindrical isidia with syncorticate apices (rather than subglobose to globose isidia with weakly epicorticate apices), larger spores (8-12.5 x 4.5-6 µm cf. 7-9 x 4.5-5.5 µm) and shorter conidia (5-6 µm cf. 7-8 µm). At present this new species is only known from the type locality.

Xanthoparmelia madeirensis Elix & Schumm, sp. nov. Fig. 3

Thallus ut in *Xanthoparmelia tinctina* sed tenuiore, arcte adnatus et acidum diffractaicum continente differt.

Type: MADEIRA. Between Caniço de Baixo and Reis Magos, 32°39'N, 16°49'W, 16 m, on dry coastal rocks, *F. Schumm,* 15 April 2001; holo: herb. Schumm 8589; iso: CANB.

Thallus small-foliose to subcrustose, tightly to very tightly adnate, 3-5 cm wide. *Lobes* ±imbricate, contiguous to separate, flat, subirregular to sublinear, irregularly branched, 0.8-1.5(-2.0) mm wide. *Upper surface* pale yellow-green, shiny at first, emaculate, soon becoming rugose, developing transverse cracks and becoming areolate in thallus centre, lacking soredia, ±lobulate, isidiate; isidia moderately dense to dense, subglobose to globose, simple; apices of isidia weakly epicorticate, intact or rarely bursting; marginal lobules subrotund, monophyllous, *ca.* 0.5 mm wide. *Medulla* white. *Lower surface* black, flat; rhizines sparse to moderate, simple, black. *Apothecia* juvenile, substipitate, *ca.* 1.0 mm wide; disc markedly concave, mid-brown; exciple smooth, margin involute. *Ascospores* ellipsoidal, 8-9 x 5-6 µm. *Pycnidia* not seen.

Chemistry. Cortex K-; medulla K+ yellow then dark red, C-, P+ orange-red; containing usnic acid (minor), salazinic acid (major), norstictic acid (minor), diffractaic acid (submajor/minor) and consalazinic acid (minor), protocetraric acid (trace).

This species is characterized by the tightly adnate, foliose thallus which becomes areolate and ±subcrustose in the centre, the black lower surface, the presence of subglobe to globose isidia with epicorticate apices, and by the presence of salazinic and diffractaic acids in the medulla. *Xanthoparmelia madeirensis* resembles the much more common and widespread *X. tinctina* (Maheu & Gillet) Hale as both have similar isidia, thalli with a black lower surface and both contain salazinic acid. However, *X. madeirensis* differs in containing additional diffractaic acid and in having a more tightly adnate thallus (adnate to loosely adnate in *X. tinctina*) and narrower lobes (0.8-2.0 mm cf. 1.5-4.0 mm wide) which become areolate in the thallus centre. At present this new species is only known from the type locality.

New Records of Parmeliaceae for Macaronesia

Hypotrachyna pulvinata (Fée) Hale, *Smithsonian Contr. Bot.* **25**: 59 (1975)

A widely distributed Neotropical species known from North, Central and South America (Hale 1975) and the Azores (Aptroot 1989).

Specimens Examined
MADEIRA. Levada da Serra do Faial, between Camacha and Portela on slope of Achada da Riba, 32°43'N, 16°50'W, 800 m, on *Quercus* in dry *Eucalyptus*-dominated forest, *F. Schumm,* 15 April 2001 (herb. Schumm 8596); Rabaçal, Lauraceae forest near 25 Fontes, 32°45'N, 17°8'W, 1070 m, *F. Schumm,* 12 April 2001 (herb. Schumm 8421); Ribeiro Frio, Lauraceae forest, 32°44'N, 16°53'W, 900 m, *F. Schumm,* 14 April 2002 (herb. Schumm 8523).

Parmelinopsis minarum (Vain.) Elix & Hale, *Mycotaxon* **29**: 243 (1987)

A cosmopolitan species known from all continents except Antarctica (Elix 1994; Hale 1976) and reported from 'Macaronesia' (Purvis & James 1992) without details.

Specimen Examined
CANARY ISLANDS. La Gomera: W of Hermigua near the Vivero de Meriga nursery, 28°09'N, 17°14'W, 820 m, on bark in Lauraceae forest, *F. Schumm,* 14 Feb. 2002 (herb. Schumm 9422).

Xanthoparmelia sublaevis (Coutinho) Hale, *Mycotaxon* **33**: 406 (1988)

A southern European species known from the Iberian Peninsula, France (Hale 1990), Italy (Giordani *et al.* 2002) and the Canary Islands (Tavares 1952).

Specimen Examined
MADEIRA. Near Portinho Flores, between Gaula and Caniço de Baixo, 32°39'N, 16°49'W, 45 m, on dry, coastal lava rocks, *F. Schumm,* 16 April 2001 (CANB, herb. Schumm 8668).

Xanthoparmelia subramigera (Gyelnik) Hale, *Phytologia* **28**: 489 (1974)

This widespread subtropical species (Hale 1990) is also known from the Canary Islands (Gyelnik 1934).

Specimen Examined
MADEIRA. Ponta de São Lourenço, near Praínha E of Caniçal, 32°45'N, 16°43'W, 111 m, on wind-exposed, lava rocks, *F. Schumm,* 17 April 2001 (herb. Schumm 8677);

between Caniço de Baixo and Reis Magos, 32°39'N, 16°49'W, 16 m, on dry coastal rocks, *F. Schumm*, 15 April 2001 (herb. Schumm 8583).

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A NEW SPECIES OF LIGNOSUS (POLYPORACEAE) FROM CAMEROON

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Abstract

Lignosus ekombitii is described as new based on a collection from Cameroon. It differs from *L. sacer* in having smaller and thinner pileus with longer and more slender stipe, oblong-ellipsoid to cylindrical and longer spores. Macro and microscopic features are illustrated. A key to species of *Lignosus* is provided.

Key words: *Lignosus ekombitii*, taxonomy, sclerotium, Mbalmayo

Introduction

The genus *Lignosus* comprises up to date four species, all growing on the ground, known from Africa, Asia and Australia (Ryvarden and Johansen, 1980). The basidiocarp is usually easy to identify being centrally stipitate and arising from a distinct sclerotium. The genus is microscopically characterised by trimitic hyphal system, generative hyphae with clamps, hyaline, binding and skeletal hyphae in context, sclerotium and stipe, no cystidia, spores smooth, ellipsoid, hyaline and non-amyloid. To date three *Lignosus* species are known from Africa, *L. dimiticus* Ryv., *L. goetzii* (Henn.) Ryv., *L. sacer* (Fr.) Ryv. (Ryvarden and Johansen, 1980), mainly from East Africa. No *Lignosus* species was recorded from Cameroon. During the survey of the mycoflora of South Cameroon, started in 2001, some specimens were collected belonging to genus *Lignosus*, but separated by some distinguishing features from the known species of the genus.

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Material and methods

The basidiocarps were collected in May 2001 during the short rainy season, in the Mbalmayo Forest Reserve, an area of 9700 ha, at 11° 14´-11° 54´ E and 3° 5´-3° 58´ N, with an average annual rainfall of 1640 mm. The type vegetation is deciduous to semi-evergreen forest. Methods of study of the morphological and anatomical features are those of Ryvarden and Johansen (1980). Free-hand thin sections of the dried material were prepared for the microscopic studies mounted in either 5% KOH or Melzer's reagent. Spore measurements were made from deposit of the spores kept on a slide, lengths and widths of 23 spores were randomly selected, and Q represents the mean length/width of the 23 spores. The microscopic characters were observed and detailed out using a grid as drawing aid representing a magnitude of × 2000. Colour terms in parentheses are those of Kornerup and Wanscher (1967).

Holotype specimens are deposited at the herbarium of Laboratory of Cryptogamy, Faculty of Science, University of Yaounde I, Cameroon (HUYI).

Taxonomic part

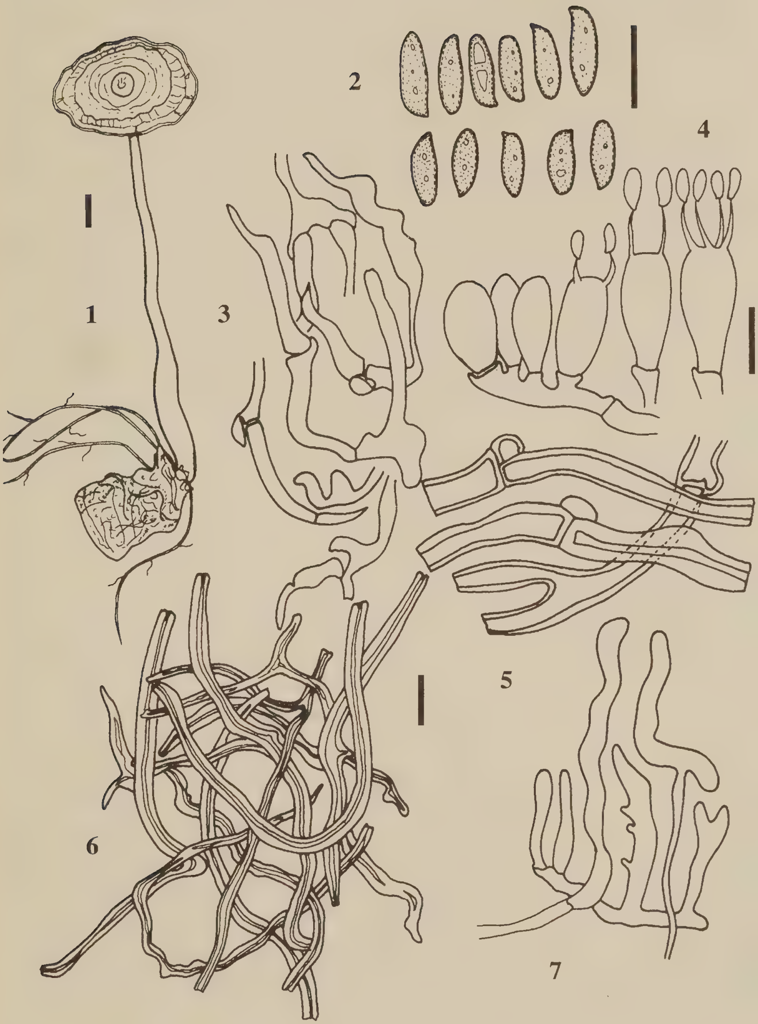
Lignosus ekombitii Douanla-Meli **sp. nov.** Figs. (1-7)

Carposoma annua, pileata, stipitatus. Pileus umbilicatus, plano vel convexus, 5 cm latus, 1.5 mm crassa, tenuis tomentosus, zonatus, laxus sulcatus, cinnamomeus-brunneus vel nigro-brunneus. Stipes ad 13 cm longa, 3-7 mm crassa, velutinus, attenuatus, basis inflatus. Sclerotium irregularis, elongatus, ad 3.5 × 2.5 cm, rugatus, ochraceus-badius, rhizomorpha ad 10 cm longa, filiformis, ramificatus, cinnamomeus-rufeus. Context candidus, ad 0.4-0.7 mm crassa, floccosus. Basidia clavata, 2-4 sporigera. Cystidia absens. Basidiospora 8.1-9.3 × 2.5-3.5 µm, ellipsoideis vel cylindricus, leves, hyalinis, inamyloideis, leviter crasse tunicatus.

Holotypus*: In silvis terram, Cameroon, Mbalmayo-Ekombitie, 11° 54´ E, 3° 58´ N, 500-650 m alt,. 17.V.2001, leg. C. Douanla-Meli, DMC 136, in herb. HUYI.*

Etymology: *ekombitii*, referring to Ekombitie the locality of the type collection.

Basidiocarp (Fig. 1) annual, single, centrally stipitate to slightly eccentrical with a more or less circular pileus, up to 5 cm in diameter, up to 1.5 mm thick in the centre, tough. **Pileus** umbilicate, applanate and becoming convex with age or when dry, smooth, covered with short, fairly entangled



Figs. 1-7. ***Lignosus ekombitii*****,** from holotype.
1. Basidiocarp with a sclerotium and rhizomorphs. **2.** Basidiopores. **3.** Generative hyphae in the hymenium. **4.** Basidia and basidioles. **5.** Generative hyphae of the tomentum (pileus and stipe). **6.** Skeletal and binding hyphae. **7.** Sterile elements of the hymenium. **Scale bars** = 2 cm for the basidiocarp, 10 μm for the microscopic features.

tomentum, concentrically zonate, finely sulcate, at margin radially wrinkled to slightly folded with an outgrowing concentric line, which also appears downwards on the hymenium, cinnamomeous-brown (6E8) to dusky-brown (12F6), and blackish purple (14F7) at the depressed centre, margin thin, deflexed, entire and regular, pileus with a distinct dark livid brown (10E5), thin cuticle contrasting the white context. **Stipe** single, up to 13 cm long, 3-7 mm thick, gradually tapering towards the pileus and enlarged at the base, slightly contorted, chestnut-brown (7E4) to light buff (3A2) near the pileus, velvety tomentose, becoming smoother with age, below the tomentum there is a distinct thin and dark livid brown (10E5) cuticle, below which the context is pure white, floccose-cottony, stipe solid, easy to break when dry. **Sclerotium** irregular, elongated, up to 3.5 cm long and 2.5 cm broad, dirty and soiled, light ochraceous-buff (5A4), rugose, wrinkled, with a thin cuticle covering a white context, easily breakable to brittle when dry, with incorporated leaves, roots and wood debris, rhizomorphs scarcely present, very long, up to 10 cm long, not above 1 mm in diameter, filiform, branched, with slender root like bristles, cinnamon-rufous (6D7), growing out from where the stipe is attached to the sclerotium. **Pore surface** white to cream colour (3A3), pore angular to elongated, thin-walled, 2-4 per mm, tubes shallow, up to 0.5 mm deep. **Context** pure white, 0.4-0.7 mm thick, tough, floccose-cottony.

Hyphal system trimitic. Generative hyphae with clamps, in the hymenium (Fig. 3) thin-walled and hyaline, 2.5-4 μm in diameter, very irregular, contorted, the tomentum both of the pileus and the stipe consisting of such hyphae (Fig. 5) up to 8 μm in diameter, very thick-walled, yellowish citrine (2D5), weakly branched, clamped, skeletal hyphae dominating the upper part of the context in the pileus, moderately straight to mostly flexuous, hyaline, thick-walled to solid, 2.5-5 μm in diameter, in the trama mixed with strongly branched, tortuous to loosely dendroid binding hyphae, thick-walled to solid, 2-4.5 μm in diameter, the context of the stipe dimitic, dominated by the binding hyphae (Fig. 6), strongly interwoven and intricate with sparsely skeletal hyphae, rhizomorphs consisting of very thick-walled, honey yellow (4B6) to hyaline hyphae, agglutinated, up to 15 μm in diameter. **Cystidia** none. Some sterile elements (Fig. 7) projecting beyond the hymenium, mostly forked at apex, or with lateral knobs, up to 50 μm long. **Basidia** (Fig. 4) clavate, hyaline, 12-15 × 5-7.5 μm, 2-4 long sterigmata, up to 6 μm long. **Basidioles** numerous, clavate, ellipsoid to oblong. **Basidiospores** (Fig. 2) give a white cream colour (3A3) spore print, oblong-ellipsoid to distinctly cylindrical, hyaline with several oil droplets, with slightly thickened walls, smooth, non-amyloid, 8.1-9.3 × 2.5-3.8 μm; Q = 2.66, (n = 23).

Distribution: Hitherto from Cameroon, in the Mbalmayo Forest Reserve-

Ekombitie, as growing in soil between the roots of undermined trees.

Discussion

The new species belongs to *Lignosus* as the basidiocarp is centrally stipitate, arising from a sclerotium on the ground. Macroscopically it is closest to *L. sacer* (Fr.) Ryv., as the general appearance, the brown colour of the pileus and as well as the white cream pore surface are similar. The hyphal system of both taxa is trimitic, and both lack cystidia. However *L. ekombitii* is distinguished by its smaller size, being smaller and thinner, stipe longer and more slender, and smaller pores, 2-4 per mm for *L. ekombitii* and 1-3 per mm for *L. sacer*; meanwhile Roy and De (1996) mentioned a length up to 19 cm and 4-5 pores per mm for *L. sacer* collected in India. The lack of hyphal pegs or protuberances on the pore surface also helps to separate *L. ekombitii* from *L. sacer*. It is also more easily distinguished from this closely related species and others species of the genus by its rhizomorphs, filiform, much longer and distinctly ramified. The spores of *L. ekombitii* are longer and narrower (8.1-9.3 × 2.5-3.8 μm) than those of *L. sacer* (5-7 × 3-4.5 μm), and they are oblong-ellipsoid to cylindrical, an uncommon spore shape in the genus (Ryvarden and Johansen, 1980), and slightly thick-walled. Hence, the conclusion is that *L. ekombitii* can be clearly distinguished from other species of *Lignosus* thus representing a new species of *Lignosus*.

Key to species of the genus *Lignosus*

1 Pileus light to dark brown..2
1' Pileus white to ochraceous...4
2 Pores up to 1-4 per mm...3
2' Pores 7-8 per mm...*L. rhinocerus*
3 Basidiospores 5-7 × 3-4.5 μm...*L. sacer*
3' Basidiospores 8.1-9.3 × 2.5-3.8 μm......................................*L. ekombitii*
4 Pores 6-8 per mm.. *L. dimiticus*
4' Pores 0.5-2 mm wide...*L. goetzii*

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TYPE STUDIES OF GYMNOPILUS (AGARICALES) I.

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ABSTRACT

As part of monographic and phylogenetic studies of the genus by the author, a complete revision of the nomenclatural type specimens of the basionyms of *Gymnopilus* was initiated. New characters not previously considered in the descriptions, as subhymenium type and metachromicity of the spores are included. Here 22 type specimens are reviewed, from ENCB, FLAS, IBUG, K, MICH, MP, NY, SFSC, TENN and XAL. Original descriptions are emended in many cases and two species names are placed in synonymy.

Keywords: taxonomy, subhymenium, metachromicity

INTRODUCTION

The author began studying the genus *Gymnopilus* (Agaricales) from Mexico in 1986 (Guzmán-Dávalos & Guzmán, 1986). Now as part of a broader study that includes the monographic treatment and the phylogenetic analysis of the genus, the revision of nomenclatural types of the basionyms is presented, with 30 specimens studied from 10 herbaria that included 22 types. Specimens from these and other herbaria will be included in following contributions. The studied material presented here was selected after a phylogenetic study of the genus in progress (Guzmán-Dávalos et al., 2003). The original descriptions are emended in many cases and two species names are placed in synonymy. Some descriptions are given with a detailed micromorphological study, but in many only the characters not previously included in the original descriptions are mentioned. In few species some remarks on the macromorphology are mentioned, especially if they were not mentioned before and there are some data from fresh material descriptions or the characteristics can be noticed on dry specimens; but as a general rule only the micromorphology is considered.

The monograph of North American species of Hesler (1969) was and still is the most complete work on the genus. There he included 73 species, from which he describes 26 as new. Hesler considered the typical characters for Agaricales for his descriptions, giving special attention to the dextrinoid character of the spores, the type of pileus trama and the presence and type of caulocystidia. Also he made a clear distinction between the cheilocystidia and pleurocystidia. On the other hand, he indicated "hyphal characters of the subhymenium are not sufficiently distinctive to serve in the separation of taxa". However, I found the subhymenium useful, because there are three different types, following Bas (1969): hyphae not differentiated (ramose), hyphae and inflated cells (inflated-ramose) and modified hyphae forming isodiametric to subglobose elements grouped in chains (cellular) (Bas, 1969).

MATERIAL AND METHODS

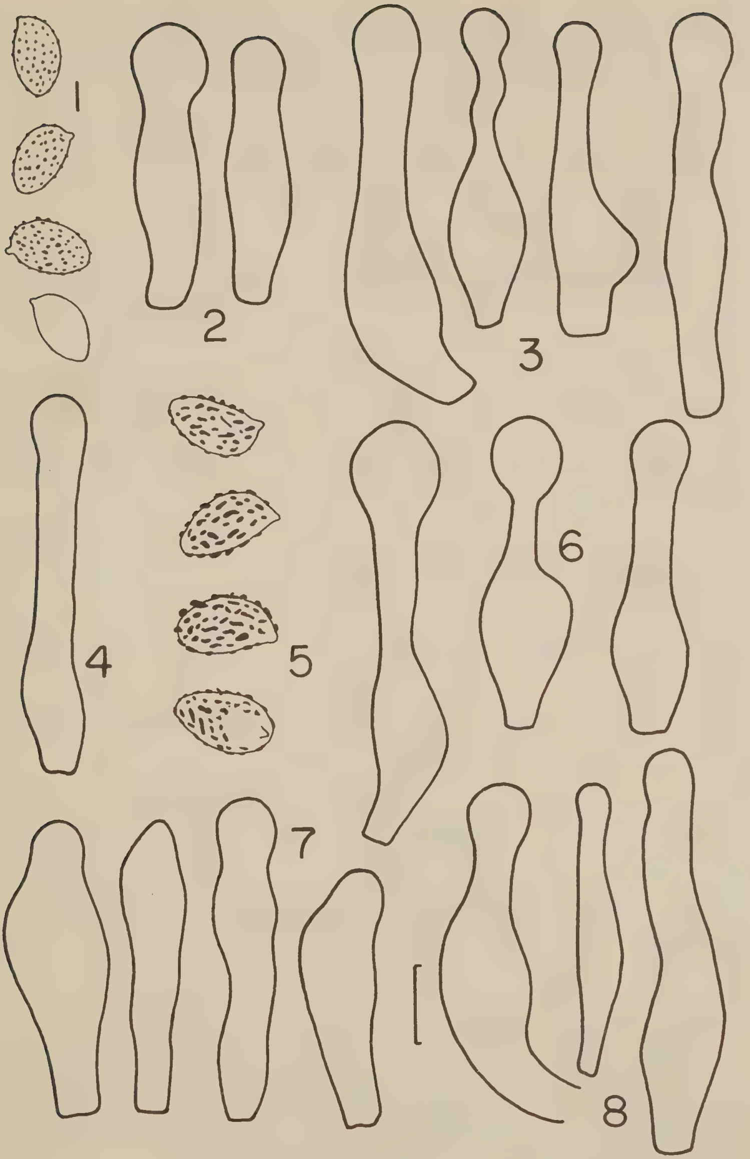
The terms for microscopic structures mainly follow Vellinga (1988). The subhymenium descriptions follow Bas (1969). The types studied are from ten herbaria: ENCB, FLAS, IBUG, K, MICH, MP, NY, SFSC, TENN and XAL, and additional materials from FH and MP. Herbarium abbreviations follow Holmgren et al. (1990). Micromorphology observations were made from material mounted in 3% KOH, Melzer's reagent, cotton blue and cresyl blue. Spore shape was determined according to Q (length-width ratio, Bas, 1969) of 20 randomly selected spores. Measurements include ornamentation but not the apiculus and made in KOH at 1000X magnification with a calibrated optical micrometer. All spores tested were cyanophilic in cotton blue (using the reagent as indicated by Hesler, 1969); for this reason this feature was not included in the descriptions. The length in basidia measurements includes sterigmata. For macrochemichal reactions 5% KOH was used. Taxa are presented alphabetically by basionym; proposed synonyms are indicated in bold at the beginning and in the discussion of the particular species.

TAXONOMY

Gymnopilus abramsii Murrill, North Amer. Flora 10: 207, 1917.

Figs. 1 – 4

Basidiospores 7.2 – 8.8 x 4.4 – 5.6 µm, Q = 1.46 – 1.69 (– 1.75), ellipsoid to oblong, with acute to obtuse apex, slightly thickened walls, verrucose, warts small to medium, without germ pore, without plage, without suprahilar depression, orange-brown in KOH, dextrinoid, not metachromatic. *Basidia* 21 – 30 x 6 – 6.4 µm, clavate, tetraspored, hyaline or yellowish, some with orange-brown content, sterigmata 2 – 7.2 (– 11.2) µm long. *Pleurocystidia* 24 – 27 x 6 µm, apex 4.1 – 7.5 µm diam., narrowly utriform, with obtuse or capitate apex, hyaline or with yellowish-brown or orange-brown content, rare. *Cheilocystidia* 30 – 39 x 6 – 9 µm, apex 4.5 – 6 µm diam., tibiiform, narrowly lageniform, utriform, with subcapitate and rarely capitate apex, hyaline, yellowish, or with orange-brown content, some with dark apex and with thicker walls. *Subhymenium* ramose. *Hymenophoral trama* subparallel. *Pileus trama*



Figs. 1 – 8. 1 – 4: *Gymnopilus abramsii,* 1: spores, 2: pleurocystidia, 3: cheilocystidia, 4: caulocystidium. 5 – 8: *G. armillatus,* 5: spores, 6: cheilocystidia, 7: pleurocystidia, 8: caulocystidia. Scale bar: 1 – 5 = 8 µm, 6 – 8 = 6 µm.

interwoven, hyphae 6 – 9.6 µm diam., thin to slightly thickened walls, yellowish. *Pileipellis* a cutis, hyphae (2.3 –) 4.5 – 6 µm diam., prostrate to suberect, thin-walled, yellowish or yellowish-orange, with encrusted pigment. *Pileocystidia* absent. *Caulocystidia* 19.5 – 46.5 x 3 – 6 µm, apex 3.4 – 5.2 µm diam., subcylindric, flexuose, with subcapitate apex, hyaline or yellowish, in tufts only at the stipe apex. *Clamp connections* present, in the pileipellis, pileus trama and subhymenium hyphae. A yellow pigment dissolves when lamellae are mounted in KOH.

KOH on dry pileus: brownish-red.

Type: USA, California, Santa Clara County, Stanford University, scattered on soil among oak leaves, November 27, 1902, *J. McMurphy s. n.* (*L. R. Abrams & J. McMurphy 65*) (NY).

Murrill (1917) described the spores oblong-fusiform, smooth and melleous. The spore warts are small, but present. Hesler (1969), among other characters, indicated the absence of pleurocystidia as a diagnostic feature; however, the pleurocystidia are present in the type material, rare but conspicuous. Also present are very abundant caulocystidia, not mentioned in Hesler' description.

Gymnopilus armillatus Murrill, Bull. Torrey Bot. Club 67: 280, 1940.

Figs. 5 – 8

Basidiospores (8.4 –) 8.8 – 11 (– 12) x (5.2 –) 5.6 – 6.4 µm, Q = (1.53 –) 1.6 – 1.85, oblong, rarely ellipsoid, amygdaliform in side view, with obtuse to acute apex, some with apical papilla, slightly thickened walls, verrucose, warts medium to large, without germ pore, with plage, with or without suprahilar depression, orange-brown in KOH, dextrinoid, not metachromatic. *Basidia* 24 – 35.2 x (4.4 –) 5.6 – 8 µm, clavate or ventricose, bi (rare) or tetraspored, hyaline or yellowish, some with orange-brown content, sterigmata 2 – 7.2 (– 11.2) µm long. *Pleurocystidia* 20 – 30 x 4.8 – 6.4 µm, ventricose, utriform or subfusiform, some subcapitate, hyaline to yellowish, rare. *Cheilocystidia* 21 – 32 x 4.8 – 7.2 µm, apex 4.4 – 7.2 µm diam., lecythiform, tibiiform, subcapitate or capitate, hyaline or with yellowish or yellowish-brown content. *Subhymenium* cellular. *Hymenophoral trama* subparallel. *Pileus trama* radial, but with interwoven zones, hyphae 5.2 – 7.6 µm diam., thin to slightly thickened walls, yellowish. *Pileipellis* a cutis with prostrate to suberect hyphae, thin-walled, yellowish. *Pileocystidia* absent. *Caulocystidia* 22.4 – 44 x 3.2 – 7.2 µm, apex 2.4 – 5.6 µm diam., subcylindric, flexuose, lecythiform, with obtuse to subcapitate apex, rarely capitate, hyaline, yellowish or yellowish-brown, in tufts present only in the stipe base. *Veil* formed by intermixed or parallel hyphae (depending on veil position), hyaline to yellow, or with orange-yellow content, without encrusted pigment. *Clamp connections* present, in the pileipellis, pileus trama, subhymenium and veil hyphae. A yellow pigment dissolves when lamellae are mounted in KOH.

KOH on dry pileus: reddish-black.

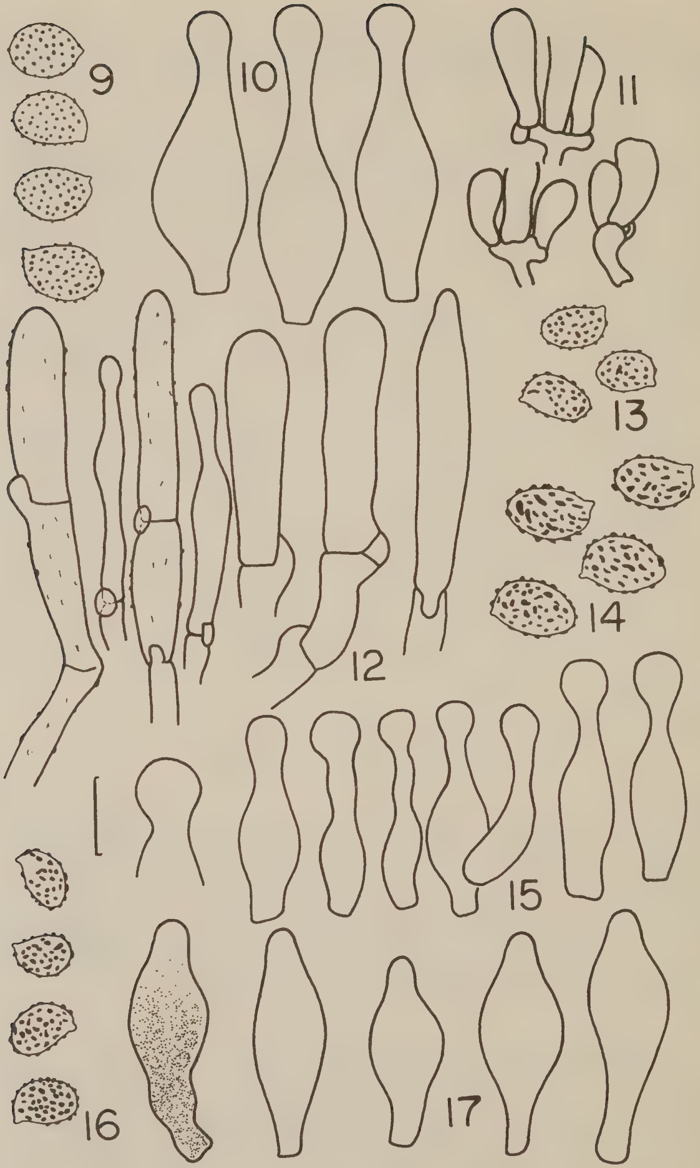
Type: USA, Florida, Orange Co., Bithlo, on the root of a living sweet-gum tree (*Liquidambar styraciflua*), December 21, 1932, A. S. Rhoads s.n. (F 15731, holotype, FLAS). Also the isotypes (MICH, NY) were reviewed.

The type specimen was found causing a whitish rot according to the collector; this was also mentioned by Murrill (1940). *G. armillatus* is morphologically closely related to *G. spectabilis* (Fr.) A. H. Sm.; a specimen annotation, P. R. Harding indicated that this material was *G. spectabilis*. Hesler (1969) distinguished both species by the non-dextrinoid spores and the pileus trama radial in *G. armillatus*; nevertheless the spores are dextrinoid in the type of *G. armillatus* and the pileus trama in European materials of *G. spectabilis* is radial and not interwoven as Hesler mentioned. Fries described also *G. junonius* (Fr.) Orton, considered by some authors as a synonym and the valid name of *G. spectabilis*. Bon & Roux (2002) accepted both of Fries' taxa and distinguished them mainly by spore size: (7 –) 8 – 9.5 (– 10) x 5 – 5.5 (– 6) µm in *G. spectabilis*, and (9 –) 10 – 11 (– 12) x 5 – 6 (– 6.5) µm in *G. junonius*. The latter also has a more slender stature. The specimens that I have reviewed in this complex with small spores (*G. spectabilis* sensu Bon & Roux) have a ramose subhymenium. However, in the specimens with big spores (*G. junonius* sensu Bon & Roux), I found two groups of subhymenia: one group with cellular subhymenium and the other with ramose subhymenium. Basidiomata stature showed no pattern. Until now, I have not seen another difference among the specimens with ramose or cellular subhymenium, so that a clear distinction cannot be drawn between the two. Further studies are needed to clarify the differences among these taxa and the status of the species in this complex. In the meantime, I consider *G. junonius* with a ramose subhymenium and *G. armillatus* with a cellular subhymenium.

Gymnopilus bryophilus Murrill, Mycologia 5: 22-23, 1913.

Figs. 9 – 12
Compilation of data included in two labels from the type collection taken when fresh are "Pileus 2 – 5 cm, convex, obtuse, dry, velvety, densely appressed-fibrillose, rich uniform ferruginous or ferruginous-brown from the first, (margin) even, not striate. Lamellae sinuate-decurrent or sinuate with decurrent tooth, crowded, broad, plane, ferruginous. Spores ochraceous-ferruginous or light ferruginous, subglobose, smooth, 6 x 5 µ. Veil not clearly seen. Stipe often eccentric, 2 – 4 cm x 3 – 4 mm, cylindrical, fibrillate, brownish or pale fuscous, solid, fleshy, yellow within."

Basidiospores 5.2 – 6.4 x (3.6 –) 4 – 4.8 µm, Q = 1.16 – 1.6, broadly ellipsoid to ellipsoid, with obtuse or subacute apex, slightly thickened walls, verrucose, warts small to medium, without germ pore, without plage and suprahilar depression, orange-brown in KOH, dextrinoid, not metachromatic. *Basidia* (17.6 –) 20 – 28.8 x 5.6 – 6.4 (– 7.2) µm, clavate or cylindric-clavate, with or without central constriction, tetraspored, hyaline or yellowish, rarely with yellowish-brown content, sterigmata 1.6 – 4.8 µm long. *Pleurocystidia* absent. *Pseudocystidia* absent or rare, 18.4 – 20.8 x 6.8 – 9.6 µm, claviform, widely rostrate, hyaline or yellowish. *Cheilocystidia* (16 –) 20.8 – 25.6 x 5.6 – 7.6 µm, apex 2.4 – 4 µm diam., lecythiform, capitate or subcapitate apex, rarely obtuse, hyaline or with yellowish or orange-



Figs. 9 – 17. 9 – 12: *Gymnopilus bryophilus*, 9: spores, 10: cheilocystidia, 11: subhymenium, 12: caulocystidia. 13: *G. capitatus*, spores. 14 – 15: *G. chrysotrichoides*, 14: spores, 15: cheilocystidia. 16 – 17: *G. dilepis*, 16: spores, 17: pseudocystidia. Scale bar: 9 – 10 = 6 μm, 11 – 12 = 12μm, 13 – 17 = 8 μm.

yellow content. *Subhymenium* ramose. *Hymenophoral trama* subparallel, hyphae 4 – 9.6 µm diam., slightly thickened walls, yellowish. *Pileus trama* radial, hyphae slightly thickened walls, yellowish. *Pileipellis* a cutis, hyphae 2.4 – 16 µm diam., prostrate to suberect, sometimes in tufts, septate, with clamp connections, thin-walled, orange-brown, with encrusted pigment. *Pileocystidia* absent. *Caulocystidia* 31.2 – 48.8 x 3.5 – 9.6 µm, clavate, cylindric, cylindric-flexuose, cylindric-ventricose, with obtuse, subcapitate or occasionally apex rostrate, hyaline to yellowish, some with scarce encrusted pigment, in tufts at stipe apex, less abundant but present at middle and base of stipe. *Clamp connections* present, in the pileipellis, subhymenium and stipe hyphae. A yellow pigment dissolves when lamellae are mounted in KOH.

KOH on dry pileus: blackish-red.

Type: Jamaica, Port Antonio, on decayed mossy log, November 24, 1902, *F. S. Earle 613* (NY).

As first noted by Horak (1989), who also studied the type specimen of *G. bryophilus,* it is characterized by a strongly eccentric stipe, sometimes almost lateral and never central in adult material. The type comprises approximately 19 well preserved specimens. The description from fresh material indicated "veil not clearly seen" (see above); however, veil rests could be observed in some specimens. Hesler (1969) described ventricose-capitate, buried pleurocystidia, and mentioned the cheilocystidia as inconspicuous. I did not find pleurocystidia; pseudocystidia were present in some basidiomata and cheilocystidia were very common and conspicuous. Horak (1989) also did not observe pleurocystidia and described cheilocystidia as fusoid with a subcapitate or conical apex. I found the majority of cheilocystidia with capitate apices.

The cystidia present on the sides of the lamellae in this species are considered pseudocystidia, because they are not constantly present, and can be absent, rare or very abundant depending on the specimen observed. In many cases they are filled with an oily or granulose yellowish to orange-brown content, and originate below the basidia. I have not observed a connection between lactiferous hyphae and cystidia. The pseudocystidia have also been observed in the following species: *G. dilepis, G. lepidotus* and *G. subearlei.*

Gymnopilus capitatus Guzm.-Dáv. & Guzmán, Rev. Mex. Mic. 2: 180, 1986.

Fig. 13

Basidiospores 6.8 – 8 x 4.4 – 5.2 (–5.6) µm, Q = 1.38 – 1.58 (– 1.67), ellipsoid, with obtuse to subacute apex, slightly thickened walls, verrucose, warts small to medium, without germ pore, with plage, without suprahilar depression, orange-brown in KOH, dextrinoid, not metachromatic. *Basidia* 24 – 47.2 x 4.8 – 8 µm, clavate, with central constriction, tetraspored, hyaline or with yellowish or yellowish-brown content, sterigmata 2.4 – 6 µm long. *Pleurocystidia* 15.2 – 26.4 x 6.4 – 10.4 µm, apex 3.6 – 6.4 µm diam., narrowly utriform, lecythiform, with short neck, subcapitate or capitate, hyaline, with yellowish content irregularly distributed, some with a yellowish drop in the apex. *Cheilocystidia* 21.6 – 36.8 x 4.4 – 10 µm, apex 3.6 – 7.6 µm diam., lecythiform, tibiiform, cylindrical, rarely narrowly utriform, with short or long neck, subcapitate or capitate, hyaline or with yellowish or yellowish-brown content. *Subhymenium* cellular. *Hymenophoral trama* subparallel, hyphae 10.4 – 16.4 µm, thin to slightly thickened walls, yellowish to yellowish-brown in mass. *Pileus trama* radial, hyphae thin to slightly thickened walls, yellowish to yellowish-brown, with lactiferous hyphae. *Pileipellis* a cutis, hyphae 4.8 – 13.6 µm diam., prostrate, thin-walled, yellowish or orange-brown, with encrusted pigment. *Pileocystidia* absent. *Caulocystidia* 14.8 – 59.2 x 3.2 – 14.4 µm, apex 2 – 7.6 µm diam., cylindrical, clavate, lecythiform, tibiiform, with obtuse, subcapitate, capitate or mucronate apex, hyaline or with yellowish, yellowish-brown, orange-brown or dark brown content, some with encrusted pigment in bands, in tufts at the apex and middle of the stipe. *Clamp connections* present, in the pileipellis, hymenophoral trama and stipe hyphae. A yellow pigment dissolves when lamellae are mounted in KOH.

Type: Mexico, Veracruz, road Orizaba to Tehuacán, S of Nogales, Huiluapan, on wood probably of *Quercus,* July 30, 1992, *G. Guzmán 30552* (XAL).

Gymnopilus chrysotrichoides Murrill, Mycologia 5: 21, 1913.
= ***Gymnopilus palmicola*** Murrill, Mycologia 5: 23, 1913.

Figs. 14 – 15
Basidiospores 8.4 – 10.4 x 5.6– 6.8 µm, Q = 1.38 – 1.57, ellipsoid, with obtuse, acute or truncate apex, slightly thickened walls, verrucose, warts large, without germ pore, without plage or only slightly evident, with or without suprahilar depression, orange-brown in KOH, dextrinoid, not metachromatic. *Basidia* 17.6 – 27.2 x 6.4 – 12 µm, clavate, tetraspored, hyaline or with granulose orange-brown content. *Pleurocystidia* absent. *Cheilocystidia* 20 – 24.8 x 4 – 6.4 µm, apex 4 – 6.8 µm diam., tibiiform, lageniform, rarely narrowly utriform, with capitate, occasionally subcapitate apex, hyaline or with granulose yellowish content. *Subhymenium* not observed. *Hymenophoral trama* subparallel, interwoven towards the join with the pileus, hyphae 4 – 17.6 µm diam., thin to slightly thickened walls, hyaline or yellowish, lactiferous hyphae present. *Pileus trama* interwoven, hyphae 2.4 – 15.2 µm diam., thin to slightly thickened walls, yellowish. *Pileipellis* a cutis, hyphae 4 – 14.4 µm diam., encrusted with pigment in bands, yellowish to orange-yellow. *Pileocystidia* absent. *Caulocystidia* not observed. *Veil* formed by hyphae 1.6 – 7.2 µm diam., intermixed, thin to slightly thickened walls, septate, with clamps, the majority without encrusted pigment, but tufts of hyphae with abundant yellowish encrusted pigment. *Clamp connections* present, only in the veil hyphae. A yellow pigment dissolves when lamellae are mounted in KOH.

KOH in dry pileus: dark blood red.

Type: Cuba, Managua, on dead coconut log (*Cocos*), October 2, 1904, *Earle 270* (NY).

The type material, which comprises more than 18 basidiomata, some of them fragmented in pieces, is not in very good condition. Murrill (1913) described this species with a glabrous pileus; however, some basidiomata in the type specimen have many little, purplish to reddish-brown scales, probably erect when fresh, and others have a fibrillose pileus. Hesler (1969) also did not take into consideration the ornamentation of the pileus and described it as in the original paper. Hesler did not observe clamp connections; I only observed clamps in the veil hyphae, mainly because of the specimen condition. Furthermore, it was not possible to observe the subhymenium and the caulocystidia.

This species has affinities with other tropical species with reddish scales on the surface of the pileus, but separate from them because of its larger spores, except from *G. palmicola* Murrill, described in the same paper by Murrill (1913) also from Cuba (see under this species). *Gymnopilus chrysotrichoides* and *G. palmicola* are very similar in all respects; the only differences between them are the radial pileus trama near the hymenium and the presence of caulocystidia in the last species. I propose these species as synonyms. Since both names are legitimate, and are of equal priority, and since no earlier synonymy of these two names has been proposed, I hereby designate ***G. palmicola*** as the correct name to use when these names are considered synonyms.

Gymnopilus dilepis (Berk. & Broome) Singer, Lilloa 22: 560, 1951.
≡ *Agaricus dilepis* Berk. & Broome, J. Linn. Soc., Bot. 11: 542, 1871.

Figs. 16 – 18
Basidiospores 6 – 7.6 x 4.8 – 6 µm, Q = 1.23 – 1.5, broadly ellipsoid to ellipsoid, with obtuse apex, slightly thickened walls, verrucose, warts medium to large, without germ pore, with plage, with or without suprahilar depression, orange-brown in KOH, dextrinoid (almost immediately). *Basidia* clavate, with or without central constriction, tetraspored, some bispored, hyaline or with yellowish or orange-brown content. *Pseudocystidia* 20 – 27.2 x 7.2 – 8.8 µm, apex 3.2 – 4.4 µm diam., utriform or clavate with a wide rostrum, to widely subfusiform with a wide apex, hyaline or with yellowish content, rarely with an oily-granulose orange-brown content, originated in the same level as the basidia or below from the tramal hyphae, abundant or rare depending on the position in the hymenophore. *Cheilocystidia* 20.8 – 30.4 x 8 – 11.2 µm, apex 2.4 – 4.8 µm diam., utriform or clavate with a wide rostrum, hyaline or yellowish, occasionally with granulose yellowish-brown content, some with incrustations in the apex, not abundant, disperse or in tufts in the lamellae edge formed by a palisade of compact cells. *Subhymenium* probably inflated-ramose. *Pileus trama* probably radial (caramelized), hyphae thin-walled, hyaline to yellowish, septate with clamp connections. *Pileipellis* a cutis, hyphae 3.2 – 8.8 µm diam., coarsely encrusted with brown pigment. *Pileocystidia* absent. *Caulocystidia* not observed. *Clamp connections* present, in the pileus trama and subhymenium hyphae. A yellow pigment dissolves when lamellae are mounted in KOH.

Type: Sri Lanka, Central Prov., Kandy Distr., Peradeniya, on dead wood, January 1859, *Thwaites 878* (K 75157).

The type consists of two small slices of the basidioma glued to a paper, almost without lamellae, plus a small slice of the pileus with broken lamellae. All the material was completely contaminated with molds, thus making observations extremely difficult; however, some structures were recovered. There was not enough stipe material present, thus caulocystidia were not observed. Pegler (1986) described the type and other materials from Sri Lanka, but he did not mention the pileus trama and caulocystidia. It was not possible to observe the metachromicity in the spores; the tissue became compress with cresyl blue and the spores were not visible. Because the shortage of material, further attempts were not tried. This species is very closely related to *G. lepidotus* Hesler (see below).

Gymnopilus fulvosquamulosus Hesler, North Amer. Sp. *Gymnopilus:* 24, 1969.

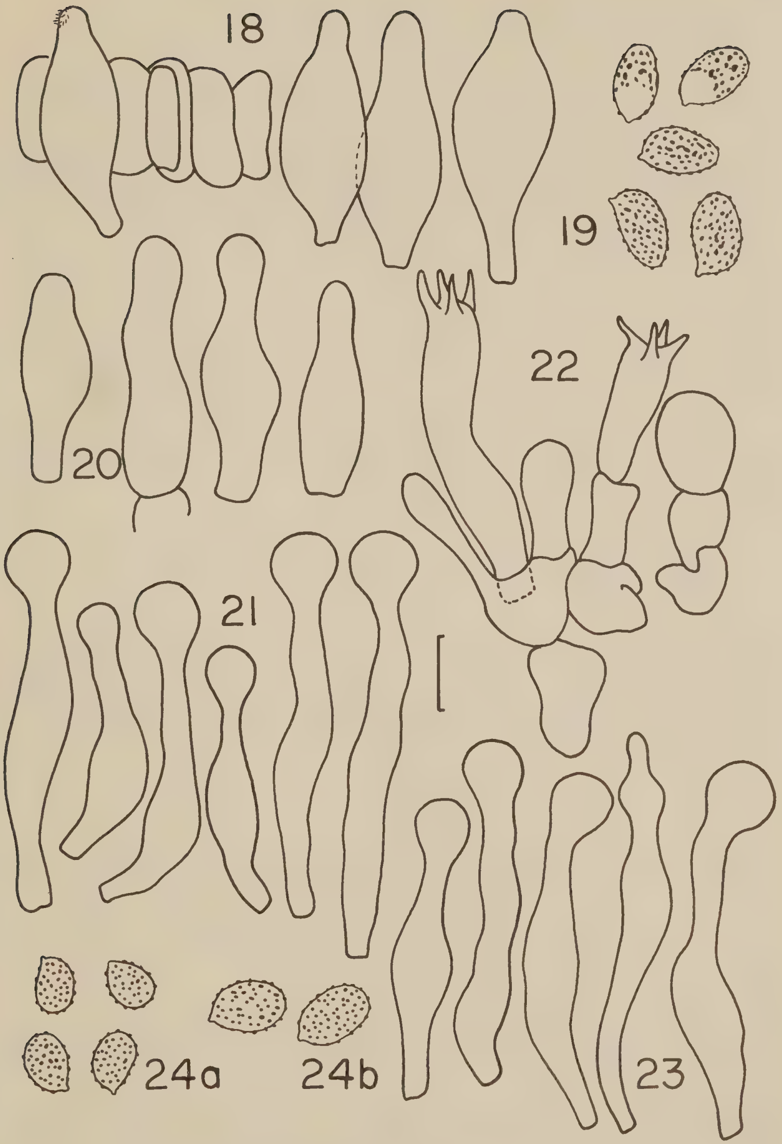
Figs. 19 – 23, 59, 65

Basidiospores (7.5 –) 8 – 11 (– 12) x 5 – 6.5 µm, Q = (1.54 –) 1.57 – 1.71 (– 1.75), ellipsoid to oblong, with obtuse apex, subacute or truncate, slightly thickened walls, verrucose, warts small to medium, without germ pore, with plage sometimes very large, without suprahilar depression or very slight, orange-brown in KOH, dextrinoid (almost immediately), metachromatic (endosporium reddish with Cresyl blue mounted in water). *Basidia* 25 – 33 (– 40.8) x 5.5 – 7 (– 8) µm, clavate, bi or tetraspored, with yellowish granulose content, sterigmata 1 – 4 µm long. *Pleurocystidia* 19 – 26 x 6 – 7 µm, apex 3 – 6 µm diam., utriform to ventricose, with obtuse to subcapitate apex, yellowish, rare. *Cheilocystidia* 28.8 – 47.2 x 4.4 – 7.2 µm, cylindric-lecythiform or cylindric-ventricose to flexuose with capitate apex, hyaline or yellowish. *Subhymenium* cellular. *Hymenophoral trama* subparallel, hyphae slightly thickened walls, yellowish. *Pileus trama* interwoven and loose to the pileipellis, radial and compact to the hymenium, hyphae thin to slightly thickened walls, hyaline to yellowish. *Pileipellis* a cutis with prostrate to suberect hyphae, orange-brown, coarsely encrusted with brown pigment. *Pileocystidia* absent. *Caulocystidia* 32 – 48 x 4 –7.2 µm, apex 4.8 – 8 µm diam., cylindric-ventricose to flexuose, with capitate apex, some with the capitelum mucronate, hyaline, with or without oily yellowish content, in tufts at the stipe apex, very abundant. *Clamp connections* present, in the hymenophoral trama and subhymenium hyphae. A yellow pigment dissolves when lamellae are mounted in KOH.

KOH on dry pileus: blackish-red in the scales and reddish-orange in the surface.

Type: USA, Michigan, Wayne Co, on hardwood, September 13, 1965, *S. Mazzer s.n. (A. H. Smith 72586)*(MICH).

Hesler (1969) described smaller spores [7 – 9 (– 10) µm] and cheilocystidia (24 – 33 µm long). The truncate apex of the spores is evident in many of them and could be a key micromorphological character. It seems that it is a common species in the USA (Smith-Weber & Smith, 1985).



Figs. 18 – 24. 18: *Gymnopilus dilepis,* cheilocystidia. 19 – 23: *G. fulvosquamulosus,* 19: spores, 20: pleurocystidia, 21: cheilocystidia, 22: subhymenium, 23: caulocystidia. 24: *G. galerinopsis,* a: spores type a, b: spores type b. Scale bar = 8 µm.

Gymnopilus galerinopsis Guzm.-Dáv., Mycotaxon 50: 335, 1994.

Fig. 24a – b
Basidiospores of two types: a) 6 – 7.2 x 4.4 – 5.2 µm, Q = 1.23 – 1.5 (– 1.64), widely ellipsoid to ellipsoid, more abundant, b) 7.6 – 8.8 x 4.8 - 5.6 µm, Q = 1.5 – 1.62, ellipsoid to oblong, less common than type a; both types: with obtuse apex, slightly thickened walls, verrucose, warts small to medium, without germ pore, without plage, without suprahilar depression, orange-brown in KOH, dextrinoid, non metachromatic. *Subhymenium* ramose. *Clamp connections* present, in the pileipellis, pileus trama and subhymenium hyphae.

KOH on dry pileus: reddish-black.

Type: Mexico, Veracruz, Municipio de Xico, 1.5 km S Ingenio El Rosario, Los Gallos, *Pinus-Abies* forest, October 9, 1986, *L. Villarreal 2684* (XAL).

This species was described with spores (6 –) 6.4 – 9.6 x 4.4 – 4.8 (– 5.6) µm, a wide range including the two types of spores that even can be appreciated in the original drawings (Guzmán-Dávalos, 1994).

Gymnopilus hemipenetrans Guzm.-Dáv., Mycotaxon 50: 338, 1994.

Fig. 25
Basidiospores 6.4 – 7.6 (– 8.4) x 4.4 – 5.2 (– 5.6) µm, Q = 1.38 – 1.58 (– 1.64), ellipsoid, rarely oblong, with obtuse or subacute apex, slightly thickened walls, verrucose, warts small, without germ pore, without plage, without suprahilar depression or very slight, yellowish-brown in KOH, dextrinoid, non metachromatic. *Subhymenium* cellular, with clamp connections.

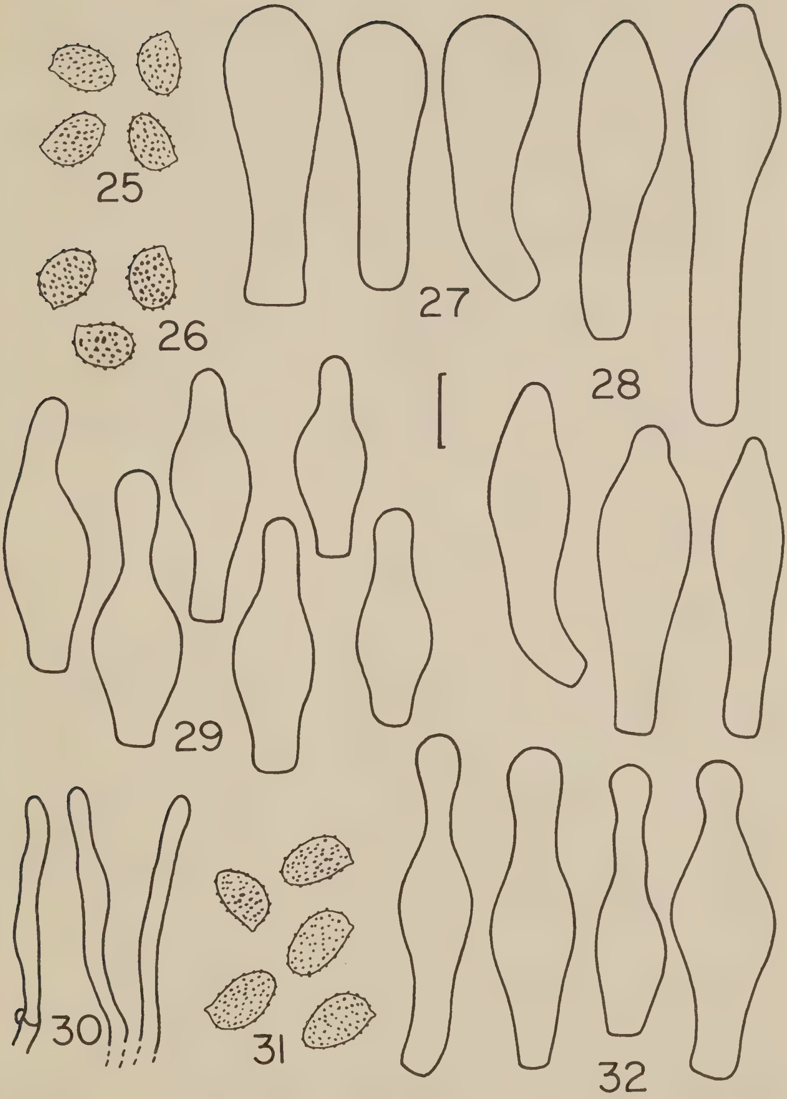
KOH on dry pileus: dark orange-brown to red.

Type: Mexico, Chiapas, km 18 road Ocozocuautla – Apic-pac, Laguna Bélgica, perennifolius tropical forest, September 18, 1992, *G. Guzmán 30519* (XAL).

This species was described with spores slightly larger, 6 – 8.8 µm long., when I re-studied the type I found they are smaller.

Gymnopilus lepidotus Hesler, North Amer. Sp. *Gymnopilus:* 40, 1969.

Figs. 26 – 30, 60
Basidiospores 6.4 – 7.2 x 4.8 – 5.6 µm, Q = 1.23 – 1.38, broadly ellipsoid or ellipsoid, with obtuse apex, slightly thickened walls, verrucose, warts medium to large, without germ pore, without plage, with or without suprahilar depression, orange-brown in KOH, dextrinoid, not metachromatic. *Basidia* 23.2 – 25.6 x 6.4 – 7.2



Figs. 25 – 32. 25: *Gymnopilus hemipenetrans*, spores. 26 – 30: *G. lepidotus*, 26: spores, 27: basidioles, 28: pseudocystidia, 29: cheilocystidia, 30: caulocystidia. 31 – 32: *G. luteocarneus*, 31: spores, 32: pleurocystidia. Scale bar: 25 – 26 & 31 – 32 = 8 µm, 27 – 29 = 6 µm, 30 = 12 µm.

µm, clavate, tetraspored, hyaline or with yellowish or orange-brown content, sterigmata 2.4 – 4 µm long. *Basidioles* 18.4 – 24 x 6.8 – 8 µm, clavate, with orange to orange-brown content. *Pseudocystidia* originated in the same level as the basidia or below from the tramal hyphae, 24 – 35.2 x 5.6 – 8 (– 12.5) µm, subfusiform, subutriform or clavate with a wide rostrum, hyaline (rare) or with yellowish content, many with an oily-granulose orange-brown content, very abundant. *Cheilocystidia* 16 – 22.4 x 5.6 – 7.2 µm, apex 2.4 – 3.6 µm diam., narrowly lageniform to utriform, with obtuse or rarely subcapitate apex, neck long or short, hyaline or with yellowish to orange-brown content; edge heteromorphous, fertile. *Hymenophoral trama* subparallel, hyphae thin to slightly thickened walls, hyaline to yellowish, lactiferous hyphae abundant. *Subhymenium* ramose. *Pileus trama* radial, hyphae thin to slightly thickened walls, hyaline to yellowish. *Pileipellis* a cutis, hyphae 4.8 – 14.4 µm diam., prostrate, some in tufts and suberect to erect forming the scales, yellowish, scarcely encrusted with brown pigment. *Pileocystidia* absent. *Caulocystidia* 30.4 – 40 x 4.8 – 6.4 µm, cylindrical, clavate, flexuose, hyaline, in tufts at the stipe apex, also in the stipe base but rare. *Veil* formed by hyphae septate, with clamps, hyaline to yellowish, with yellowish encrusted pigment in bands, lactiferous hyphae also present but rare. *Clamp connections* present, in the pileipellis, hymenophoral trama, subhymenium, veil and stipe hyphae. A yellow pigment dissolves when lamellae are mounted in KOH.

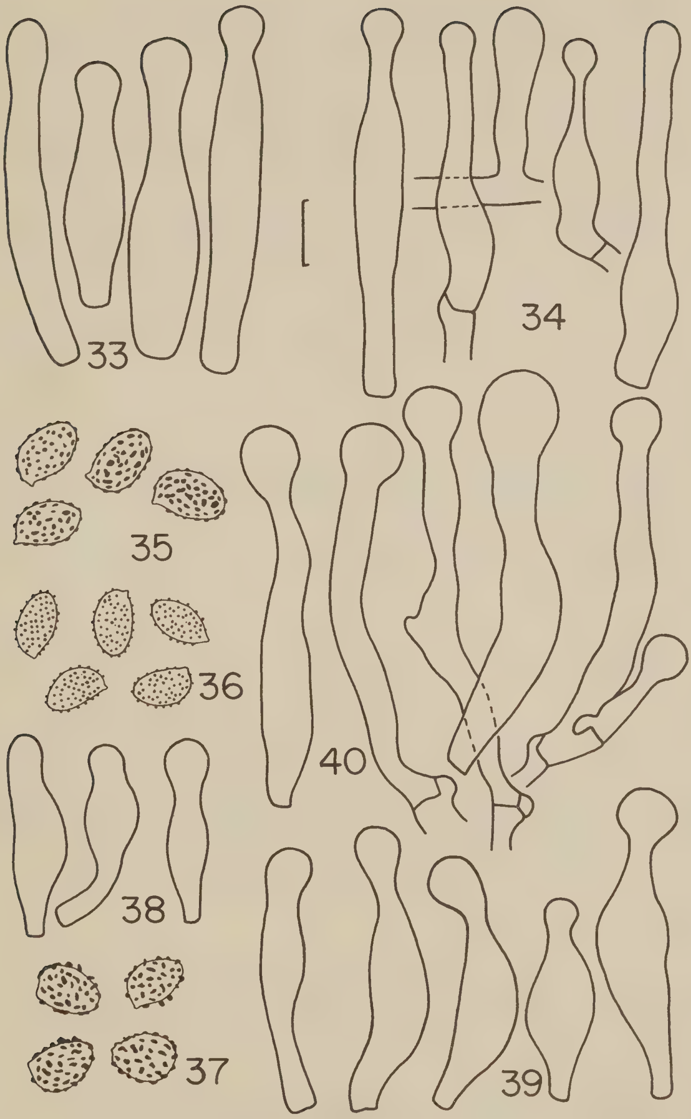
KOH on dry pileus: dark blood-red.

Type: USA, Florida, Natural Bridge, on gum log, July 31, 1954, *T. H. Campbell 21453* (TENN).

The type material has about 14 basidiomata, the majority in good shape. Hesler (1969) described the pileus as 4 – 8 mm, surely a mistake, because even in dry specimens they are bigger. In the type there is a typewritten description by Hesler which gave measures "9 (?) – 22 mm" as the size of the pileus in fresh specimens; these numbers are crossed out, maybe by Hesler himself. This species is very similar to *G. dilepis* and probably a synonym. The differences are the form of the cheilocystidia, widely rostrate and without a neck in *G. dilepis,* the distribution, Paleotropical for *G. dilepis* and Neotropical for *G. lepidotus* and probably the subhymenium. In the type of *G. dilepis* it was not possible to clarify with exactitude the subhymenium type; however, in specimens of this species from India, the subhymenium was ramose-inflated (Thomas et al., 2003).

Gymnopilus luteocarneus Hesler, North Amer. Sp. *Gymnopilus:* 62, 1969.

Figs. 31 – 34
Basidiospores 7.2 – 8.8 x 4.4 – 5.6 µm, Q = 1.5 – 1.73, ellipsoid to oblong, with obtuse or acute apex, slightly thickened walls, verrucose, warts small, without germ pore, without plage, without suprahilar depression or very slight, orange-brown with reddish tinges in KOH, dextrinoid, not metachromatic. *Basidia* 24.8 – 33.6 x 5.6 – 8.4 µm, clavate, with or without central constriction, tetraspored, hyaline, sterigmata 3.2



Figs. 33 – 40. 33 – 34: *Gymnopilus luteocarneus,* 33: cheilocystidia, 34: caulocystidia. 35: *G. medius,* spores. 36: *G. nevadensis,* spores. 37 – 40: *G. oregonensis,* 37: spores, 38: pleurocystidia, 39: cheilocystidia, 40: caulocystidia. Scale bar = 8 µm.

– 4.8 µm long. *Pleurocystidia* 28.8 – 36 x 7.2 – 11.2 µm, apex 4.4 – 5.6 µm diam., utriform, narrowly lageniform to lecythiform, with obtuse or subcapitate apex, neck long or short, hyaline, rarely with yellowish content mainly to the apex, rare but conspicuous. *Cheilocystidia* 29.6 – 44 x 5.2 – 8.8 µm, apex 5.2 – 6.4 µm diam., cylindrical to narrowly lageniform, with subcapitate or capitate apex, hyaline, many with yellowish content. *Hymenophoral trama* subparallel, hyphae thin-walled, hyaline to yellowish, some with yellowish encrusted pigment. *Subhymenium* ramose. *Pileus trama* radial, hyphae thin to slightly thickened walls, hyaline. *Pileipellis* a cutis, hyphae 2.4 – 9.6 µm diam., prostrate with endings suberect, orange-brown, with encrusted pigment. *Pileocystidia* absent. *Caulocystidia* (20 –) 25.6 – 46.4 x 3.6 – 7.2 µm, apex 4 – 6 µm diam., cylindrical, cylindric-ventricose or narrowly lageniform, with an obtuse, subcapitate or capitate apex, occasionally clavate, hyaline, or with yellowish content, very abundant at the stipe apex, forming a palisade. *Clamp connections* present, in the hymenophoral trama, subhymenium and stipe hyphae. No pigment dissolves when lamellae are mounted in KOH.

KOH on dry pileus: dark red.

Type: USA, California, Marin Co., Alpine Lake, solitary to scattered on dead conifer logs, November 30, 1964, *H. D. Thiers 11815* (SFSC).

Hesler (1969) described the pleurocystidia longer, 34 – 44 µm long, I found shorter.

Gymnopilus medius Guzm.-Dáv., Mycotaxon 50: 339, 1994.

Fig. 35
Basidiospores 8 – 10 (– 10.8) x 5.2 – 6 (– 6.4) µm, Q = 1.4 – 1.6 (– 1.67) (– 1.8), ellipsoid, rarely oblong, with obtuse, subacute or shortly truncate apex, slightly thickened walls, verrucose, warts medium to large, without germ pore, with indistinct plage, but in some spores conspicuous, with suprahilar depression, orange-brown in KOH, dextrinoid, no metachromatic. *Subhymenium* cellular. *Clamp connections* present, in the pileipellis, hymenophoral trama and subhymenium hyphae.

KOH on dry pileus: dark red.

Type: Mexico, Veracruz, Municipio de Actopan, Estación Biológica El Morro de la Mancha, deciduous tropical forest, April 19, 1990, *J. García-Franco s.n.* (XAL).

Gymnopilus nevadensis Guzm.-Dáv. & Guzmán, Mycotaxon 41: 49, 1991.

Fig. 36
Basidiospores (6.8 –) 7.2 – 8.8 (– 9.6) x 4 – 5.2 µm, Q = (1.42 –) 1.5 – 1.73, ellipsoid to oblong, with obtuse or subacute apex, slightly thickened walls, verrucose, warts small, without germ pore, without plage, with or without suprahilar depression,

yellowish-brown to orange-brown in KOH, dextrinoid, non metachromatic. *Subhymenium* probably cellular. *Clamp connections* present, in the pileipellis and hymenophoral trama hyphae.
KOH on dry pileus: dark brownish-red.

Type: Mexico, Jalisco, Municipio de Zapotlán el Grande, Nevado de Colima foothills, El Floripondio, *L. Guzmán-Dávalos 3469* (IBUG).

The type is not in very good condition. The subhymenium apparently was cellular before dispersing the material; however, it is impossible to see individual elements because they became degraded.

Gymnopilus oregonensis Murrill, North Amer. Flora 10: 207, 1917.

Figs. 37 – 40
Basidiospores 7.2 – 8.8 x 5.6 – 6.8 µm, Q = 1.25 – 1.47, ellipsoid, some widely ellipsoid, with truncate apex, slightly thickened walls, verrucose to almost tuberculate, warts large to very large, without germ pore (but see discussion below), without plage or not very evident, without suprahilar depression, light ferruginous-brown in KOH, dextrinoid, non metachromatic. *Basidia* 25.6 – 38.8 x 6.4 – 7.6 µm, clavate, with or without central constriction, tetraspored, hyaline or with yellowish content, sterigmata 3.6 – 7.2 µm long. *Pleurocystidia* 20.8 – 25.6 x 3.2 – 5.6 µm, apex 4 – 4.8 µm diam., utriform or cylindric-ventricose, subcapitate, hyaline or yellowish, common. *Cheilocystidia* 24 – 36 x 5.6 – 9.6 µm, apex 4 – 6.4 µm diam., lecythiform or cylindric-ventricose, subcapitate or capitate, hyaline or yellowish. *Hymenophoral trama* subparallel, hyphae 10 – 17.2 µm diam., thin, slightly thickened to thick walls, hyaline to yellowish. *Subhymenium* ramose. *Pileus trama* radial, hyphae 2.4 – 8 µm diam., thin to sub-thick walled, hyaline to yellowish. *Pileipellis* a cutis, hyphae 2.4 – 17.6 µm diam., prostrate, strongly encrusted with orange pigment. *Pileocystidia* absent. *Caulocystidia* (14.4 –) 24 – 60 x 4 – 8 µm, apex 4.8 – 9.2 µm diam., cylindrical, flexuose or narrowly lecythiform, with capitate apex, occasionally subcapitate, hyaline or with yellowish or orange content, in a palisade at the stipe apex. *Clamp connections* present, in the pileipellis, hymenophoral trama, subhymenium and stipe hyphae. A yellow pigment does not dissolve when lamellae are mounted in KOH.

KOH on dry pileus: blackish-red.

Type: USA, Oregon, Glen Brook, on fir log, November 7, 1911, *W. A. Murrill 739* (NY).

This species is distinct from others in the genus by its tuberculate spores, with a truncate apex, and the absence of yellow pigment when lamellae are mounted in KOH. Because the spores have a truncate apex, they can mistakenly be thought to have a germ pore; no species of *Gymnopilus* is known with a germ pore. Murrill (1917) described the spores as "finely echinulate", and then Hesler (1969) as "minutely verruculose", surely a mistake because in Hesler's notes, kept with the type material, he wrote down “warty-tuberculate”. Also Hesler (1969) did not mention the presence of caulocystidia, and specifically stated the absence of clamp connections, both present in the type.

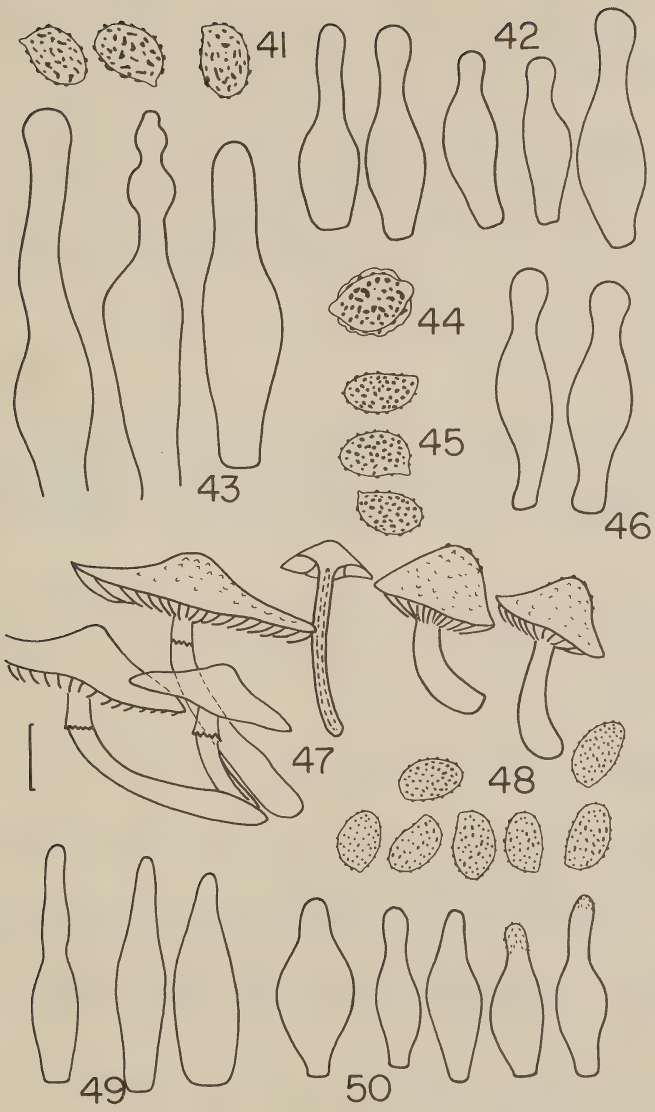
Gymnopilus palmicola Murrill, Mycologia 5: 23, 1913.
= *Gymnopilus chrysotrichoides* Murrill, Mycologia 5: 21, 1913.

Figs. 41 – 43, 61
Data included in the type material: “Pileus 2 – 5 cm, convex to expanded or at length depressed, pale ferruginous to ochraceous, dry, floccose-squamose, (margin) even, not striate. Lamellae adnate, subcrowded, broad, at length ventricose, dull amber, stained ferruginous by spores. Spores ferruginous, echinulate-punctate, 10 x 6 µ. Veil strongly developed, pale yellowish, subannulate. Stipe 3 – 5 cm x 3 – 5 mm, cylindrical, slightly fibrillate, subconcolorous but paler, solid, fleshy, pale yellow within. Observed from dried specimens, no note in the fresh plant”. In the dry material squamules present on the pileus are darker than the surface or background, dark orange-brown to reddish-brown on a yellowish surface.

Basidiospores 8 – 11.2 (– 12) x (5.2 –) 5.6 – 7.2 (– 8) µm, Q = 1.33 – 1.75, ellipsoid, with obtuse or truncate apex, slightly thickened walls, verrucose to almost tuberculate, warts large to very large, without germ pore, without plage, with suprahilar depression, orange-brown in KOH, dextrinoid, not metachromatic. *Basidia* 28 – 32 x 7.2 – 10.4 µm, clavate, without central constriction, tetraspored, hyaline or with yellowish or yellowish-brown content, sterigmata 1.6 – 4 µm long. *Pleurocystidia* absent. *Cheilocystidia* 20.8 – 28.8 x 5.6 – 8.4 µm, apex 3.2 – 4.8 µm diam., narrowly lageniform, utriform, with obtuse or subcapitate apex, neck short or long, hyaline or with yellowish content. *Hymenophoral trama* subparallel, hyphae 10 – 15.6 µm diam., thin, slightly thickened walls, hyaline to yellowish, some with encrusted walls. *Subhymenium* cellular, yellowish. *Pileus trama* interwoven but radial near the hymenium, hyphae 10.8 – 20.4 µm diam., thin, slightly thickened walls, hyaline to yellowish. *Pileipellis* a cutis, hyphae 4.4 – 12.8 µm diam., prostrate, yellowish, with encrusted yellowish-brown pigment. *Pileocystidia* absent. *Caulocystidia* 44 to very large (continuous with stipe hyphae) x 5.2 – 6 µm, narrowly sublageniform, ventricose, with obtuse apex, subcapitate or moniliform, very rare, in tufts at the stipe apex. *Clamp connections* present, in the pileus trama and subhymenium hyphae. A yellow pigment dissolves when lamellae are mounted in KOH.

KOH on dry pileus: reddish-orange.

Type: Cuba, near Baracoa, at the base of El Yunque, Cooper’s ranch, caespitose on dead logs of royal palm (*Oreodoxa*), March 1903, *L. M. Underwood & F. S. Earle 1134* (NY).



Figs. 41 – 50. 41 – 43: *Gymnopilus palmicola,* 41: spores, 42: cheilocystidia, 43: caulocystidia. 44: *G. robustus,* spore. 45 – 46: *G. rufosquamulosus,* 45: spores, 46: cheilocystidia. 47 – 50: *G. subearlei,* 47: basidiomata, 48: spores, 49: pseudocystidia, 50: cheilocystidia. Scale bar = 8 µm, except 47 = 105 mm.

Additional specimens: Mexico, Oaxaca (developed in a greenhouse in Cambridge, Massachusetts, USA), on living orchid, October 25, 1946, *R. Singer s.n.* (FH). USA, Florida, near Sebring, Highlands Hammock, State Park, on fallen trunks of Sabal palmetto, September 4, 1942, *R. Singer s.n.* (F-545, FH).

The type comprises four basidiomata, only one complete, all of them with the veil missing. Hesler (1969) described pleurocystidia "26 – 35 x 6 – 8 µ, colorless, clavate, at times mucronate", and Pegler (1987) indicated pleurocystidia as abundant, "cylindric-fusoid, occasionally mucronate, either hyaline or with dark ferruginous contents". I did not find pleurocystidia, and maybe the cystidia observed by Hesler and Pegler were basidioles or pseudocystidia, which presence is quite variable according to the specimen observed. Hesler did not observe caulocystidia, but R. E. Halling did, present at the stipe apex, scattered, and sometimes collapsed, according to an annotation from September 30, 1985. It seems that caulocystidia are not very consistent in this species.

As mentioned under *G. chrysotrichoides,* I propose these species as synonyms and have designated ***G. palmicola*** as the correct name for the species. The major reason for this choice is that the type specimen of the latter is in better condition. The pileus with reddish squamules, and the large spores with a truncate apex and large warts are all characteristic of this species. The habitat is mainly on palms.

The specimens collected by Singer were determined by him as *G. aculeatus* (Bres. & Roumg.) Singer (Singer, 1951); however, this species has spores 7 – 6 x 4 – 4.5 µm according to the original description of *Pholiota aculeata* Bres. & Roumg. (Bresadola and Roumeguère, 1890). So these specimens correspond to *G. palmicola* (Hesler, 1969; Guzmán-Dávalos, 1996).

Gymnopilus robustus Guzm.-Dáv., Mycotaxon 50: 343, 1994.

Fig. 44
For a complete macro- and micromorphological description see Guzmán-Dávalos & Ovrebo (2001). Here I mention only new data.

Basidiospores non metachromatic. *Subhymenium* ramose. *Clamp connections* present, in the pileipellis, pileus trama, subhymenium and stipe hyphae.

Type: Mexico, Nayarit, Municipio de Las Varas, road Chacala – Chacalilla, gregarious on a rotten palm stipe, November 21, 1986, *O. Vargas 19* (IBUG).

Gymnopilus rufosquamulosus Hesler, North Amer. Sp. *Gymnopilus:* 28, 1969.

Figs. 45 – 46, 66
Basidiospores 8 – 10 X 5.2 – 6 µm, Q = 1.43 – 1.71, ellipsoid to oblong, with obtuse apex, slightly thickened walls, verrucose, warts medium, without germ pore, without plage or almost not evident, with very slight or without suprahilar depression, orange-

brown in KOH, dextrinoid, not metachromatic. *Basidia* 21 –25 x 6 – 8 µm, clavate, bi or tetraspored, hyaline, sterigmata 2 – 4 µm long. *Pleurocystidia* absent. *Cheilocystidia* 21.6 – 28.8 x 6 – 8 µm, apex 4 – 5 µm, lecythiform, utriform, with obtuse to capitate apex, hyaline or yellowish. *Hymenophoral trama* subparallel, hyphae hyaline to yellowish. *Subhymenium* cellular. *Pileus trama* interwoven, hyphae thin to slightly thickened walls, hyaline to yellowish. *Pileipellis* a cutis, hyphae prostrate, hyaline or yellowish-brown, occasionally with encrusted pigment. *Pileocystidia* absent. Terminal elements of cutis 44 – 57 x 7 – 13 µm, clavate, cylindrical, yellowish-brown, some with encrusted pigment. *Caulocystidia* absent. *Clamp connections* present, in the pileipellis and hymenophoral trama hyphae. No pigment dissolves when lamellae are mounted in KOH.

KOH on dry pileus: dark red.

Type: USA, Texas, Arkansas Co., Rockport, on oak trees, August 25, 1966, *J. Dean 70* (MICH).

The type specimen has two well-preserved basidiomata. In dry condition some areas of green pigment can be observed on the pileus surface. Hesler (1969) described pileocystidia 30 – 60 x 7 – 11 µm. True pileocystidia are not present in the type material, there are only terminal hyphae not really differentiated from the hyphae.

Gymnopilus subearlei Valenzuela, Guzmán & Castillo, Bol. Soc. Mex. Mic. 15: 91, 1981.

Figs. 47 – 51, 67 – 68
Compilation of the macroscopic description from the original diagnosis (Valenzuela et al., 1981), from Guzmán (1977), from field notes and observations on dry material:

Pileus 1 – 5 (– 12) cm diam., conic to convex, fibrillose to squarrose to scaly on the disk, sometimes areolate, yellow, orange-yellow, ferruginous, fibrils and scales orange-brown, reddish-brown or purplish, dry. Lamellae adnate to narrowly adnate, sometimes with a decurrent tooth, ventricose, orange-brown to ferruginous. Stipe 2 – 5.5 (– 8) x 0.3 – 1.4 (– 4) cm, equal or enlarged downward, some with a subbulbous base, fibrillose, hollow, surface whitish to yellowish, brownish-red when bruised, base staining green, base with scant white mycelia. Veil well developed, forming a thick lacerate annulus in young materials, evanescent leaving fibrils in mature specimens. Context thin to thick in the disk, whitish, yellowish or pale orange; odor strong, fungoid or as fruits; taste insipid or slightly pungent after few minutes.

Basidiospores 6.4 – 8.8 (– 9.6) x 4.4 – 5.6 (– 6.4) µm, Q = 1.26 – 1.75, ellipsoid, some widely ellipsoid or oblong, with obtuse or subacute apex, slightly thickened walls, verrucose, warts small to medium, without germ pore, without plage or very indistinct, with or without suprahilar depression, orange-brown in KOH, dextrinoid, non metachromatic. *Basidia* 21.6 – 32.8 x 5.6 – 8 µm, clavate to cylindric-clavate, without central constriction, tetraspored, hyaline or with yellowish,

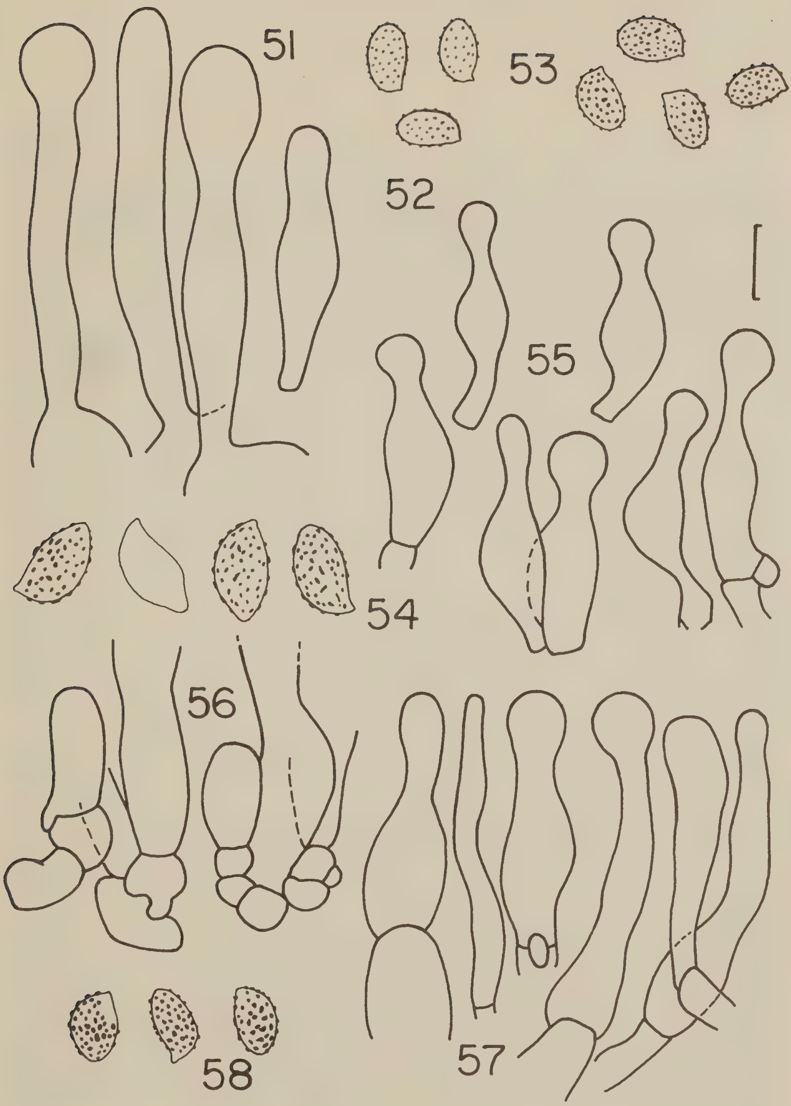
yellowish-brown or orange-brown content, sterigmata 1.6 – 4.8 µm long. *Basidioles* 24 – 32.8 x 6.4 – 7.6 µm, clavate with central constriction or utriform, hyaline, with yellowish-brown to orange-brown content. *Pseudocystidia* 25.6 – 28.8 x 5.6 – 8 µm, subfusiform, or narrowly lageniform, hyaline or with yellowish content, rare, more frequent in basidiomata with deformed basidia with abundant orange-brown oily content. *Cheilocystidia* 18.4 – 32.8 x 5.6 – 9.2 µm, apex 2.8 – 4.8 µm diam., narrowly lageniform to utriform, with obtuse or occasionally subcapitate apex, neck long or short, hyaline or with yellowish to orange-brown content, occasionally with encrusted apex. *Hymenophoral trama* subparallel, hyphae 10.4 – 33.6 µm diam., thickened or slightly thickened walls, hyaline to yellowish. *Subhymenium* cellular, elements thin-walled, with yellowish or yellowish-orange content. *Pileus trama* with interwoven hyphae, intermixed with zones of hyphae disposed radially, especially to the lamellae, thickened or slightly thickened walls, hyaline to yellowish or yellowish-orange. *Pileipellis* a cutis, hyphae prostrate, thin-walled, hyaline or yellowish, hyphae from the scales with yellowish to yellowish-brown granulose content, rarely with encrusted pigment. *Pileocystidia* absent. *Caulocystidia* 21.6 – 57.6 x 3.6 – 9.2 µm, apex 4 – 8.8 µm diam., cylindrical, clavate, occasionally narrowly utriform, with obtuse, subcapitate, capitate or rostrate apex, hyaline or with yellowish-brown or orange-brown content, in tufts at the stipe apex, rare and clavate at the middle part of the stipe. *Clamp connections* present, few and poor developed in the pileus and hymenophoral trama hyphae; abundant and well developed in the stipe and veil hyphae. *Lactiferous hyphae* with yellowish or orange-brown oily content, very abundant in some basidiomata. An intense yellow pigment dissolves when lamellae are mounted in KOH.

KOH on dry pileus: dark blood-red.

Type: Mexico, Jalisco, road Manzanillo to Puerto Vallarta, W of Bahía de Tenacatita, Bahía de La Manzanilla, gregarious on dead or burnt wood, July 11, 1974, *G. Guzmán 11648-A* (ENCB).

This species is very distinctive by its thick-walled hyphae of the pileus and hymenophoral trama and also for its cellular subhymenium. It is close to *G. dilepis* and *G. lepidotus,* due to the form of cheilocystidia and the presence of pseudocystidia, as well as the reddish-brown squamules on the pileus, but these species have hyphae with thin to slightly thickened walls and the subhymenium ramose. Another important macromorphological difference with these species is that *G. subearlei* stains green when bruised, probably being a hallucinogenic species. However, this character is not always present. It seems that the greenish bruising depends on the humidity conditions of the specimens. The type description did not indicate some change when bruised, but the description of fresh material mentioned a green stipe base as well as the description of Guzmán (1977) as *G. earlei*. I have found the green stains in other specimens of this species but inconsistently.

The basidiomata sketches (fig. 47) were directly taken from the field notes made by Guzmán. Modifications of those were published by Guzmán (1977).



Figs. 51 – 58. 51: *Gymnopilus subearlei,* caulocystidia. 52: *G. suberis,* spores. 53: *G. subpurpuratus,* spores. 54 – 57: *G. subspectabilis,* 54: spores, 55: cheilocystidia, 56: subhymenium, 57: caulocystidia. 58: *G. tuxtlensis,* spores. Scale bar = 8 μm, except 57 = 11. 5 μm.

Gymnopilus suberis (Maire) Singer, Lilloa 22: 561, 1951.
≡ *Pholiota suberis* Maire, Bull. Soc. Mycol. France 44: 45, 1928.
≡ *Fulvidula suberis* (Maire) Singer, Rev. Mycol. 2: 239, 1937.

Fig. 52
Basidiospores 6.2 – 7.8 (– 8.4) x 3.9 – 5 µm, Q = 1.4 – 1.87, ellipsoid, occasionally oblong, with obtuse apex, slightly thickened walls, verrucose, warts small, without germ pore, without plage, without suprahilar depression, orange-brown in KOH, dextrinoid. *Cystidia* not observed. *Pileipellis* a cutis, hyphae prostrate, thin-walled, hyaline or with granulose yellowish content. *Caulocystidia* not observed; stipe with abundant lactiferous hyphae, 5.6 – 11.2 µm diam., flexuose, yellowish. *Clamp connections* not observed.

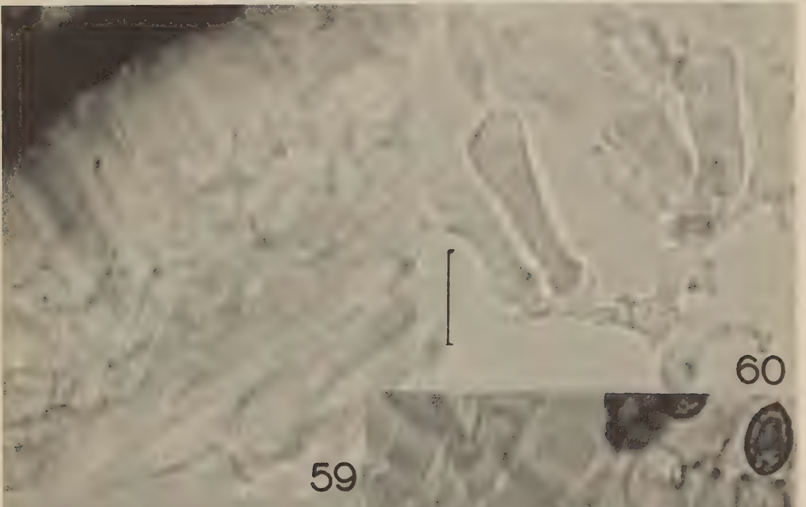
Type: North Africa, Algeria, La Réghaïa, on *Quercus suber,* October 19, 1915, *R. Maire 3817* (MP).

Additional specimens: North Africa, Algeria, La Réghaïa, on dead trunks of *Quercus suber,* November 12, 1911, *R. Maire 46* (MP). North Africa, Guerrouch, Mirbeckii Dur., on *Quercus suber,* December 31, 1911, *R. Maire 366* (MP). North Africa, Algeria, Baïnem forest, on *Quercus suber,* November 7, 1920, *R. Maire 7269* (MP). Catalonia, Olzinelles, on trunks of *Quercus suber,* October 26, 1939 (or 1936?), *R. Maire s.n.* (MP). The range of spores' size in these specimens is 6.2 – 8.4 (– 8.9) x 3.9 – 5 (– 6.2) µm.

The type specimens are 6 basidiomata apparently in good shape, but moldy under the microscope. Unfortunately MP has not external loans, so specimens have to be studied there and the microscopic facilities were not very good. This factor, joined with the bad condition of all the materials, included the type, prevented the observation of almost all the structures. The basidiomata are small to medium and the pileus glabrous to fibrillose, dark orange-brown or reddish-brown. The drawing of the type shows a mature basidioma with glabrous pileus, but a younger basidioma with erect squamules is pictured; the squamules are not observed in dry specimens. Because of the size and color of the basidiomata, as well as the size and form of the spores, it seems to be an independent species, not related to *G. spectabilis,* as it was suggested by Singer (1986).

Gymnopilus subpurpuratus Guzm.-Dáv. & Guzmán, Mycotaxon 41: 50-51, 1991.

Fig. 53, 69
Basidiospores 6.4 – 7.6 (– 8.4) x 4.4 – 5.2 µm, Q = 1.36 – 1.55 (– 1.64), ellipsoid, rarely oblong, with obtuse or subacute apex, slightly thickened walls, verrucose, warts small to medium, without germ pore, without plage or almost not evident, with or without suprahilar depression, yellowish-brown in KOH, dextrinoid, non-metachromatic. *Subhymenium* ramose. *Clamp connections* present, in the pileipellis, pileus trama, subhymenium, stipe and veil hyphae. *Veil* formed by intermixed hyphae or groups of subparallel hyphae, thin-walled, septate, yellowish, with encrusted pigment in their walls.



Figs. 59 – 65. 59 and 65: *G. fulvosquamulosus*, cellular subhymenium. 60: *G. lepidotus*, ramose subhymenium. 61: *G. palmicola*, cellular subhymenium. 62 – 63: *Gymnopilus subspectabilis*, cellular subhymenium. 64: *G. tuxtlensis*, cellular subhymenium. Scale bar = 10 µm.

KOH on dry pileus: brownish-red.

Type: Mexico, Jalisco, Municipio de Zapopan, Nextipac, Guadalajara University, Instituto de Botánica, *L. Guzmán-Dávalos 4773* (IBUG).

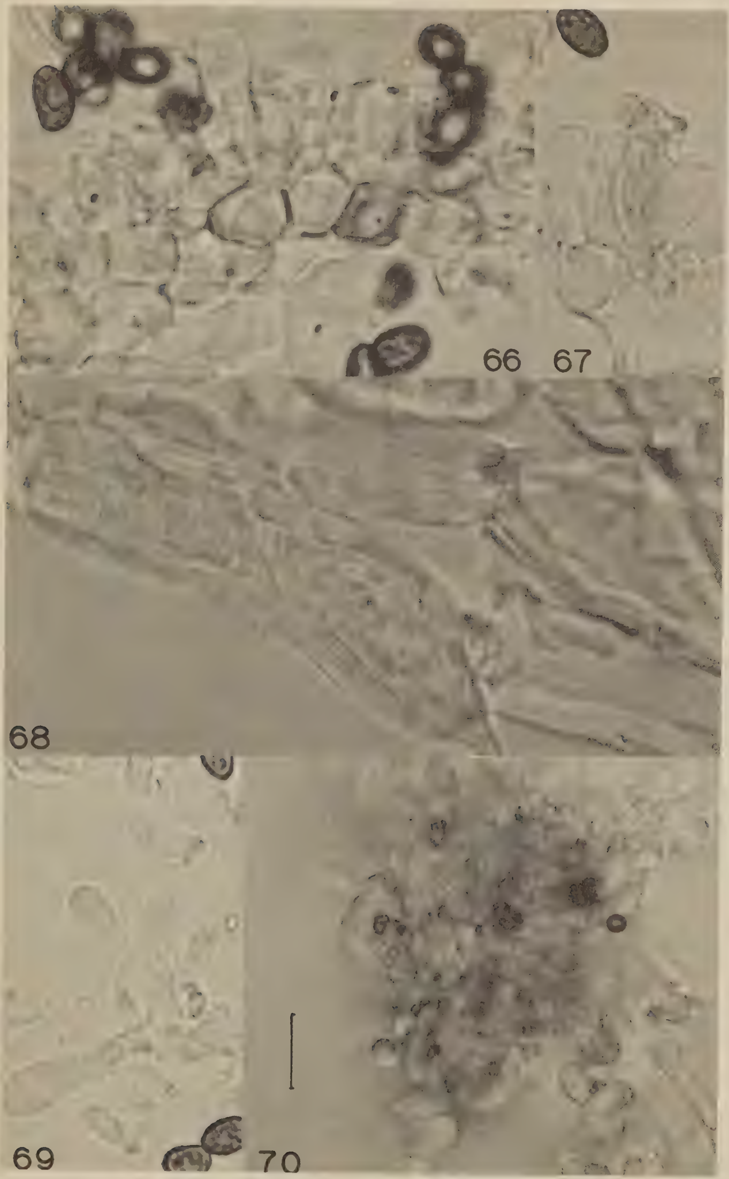
Gymnopilus subspectabilis Hesler, North Amer. Sp. *Gymnopilus:* 21, 1969.
= ***Gymnopilus armillatus*** Murrill, Bull. Torrey Bot. Club 67: 280, 1940.

Figs. 54 – 57, 62 – 63, 70
Basidiospores 8.8 – 11.6 x (5.6 –) 6 – 6.8 (– 7.2) µm, Q = 1.5 – 1.81, oblong to ellipsoid, amygdaliform in side view, with obtuse to acute apex, some with apical papilla which could be devoid of ornamentation, slightly thickened walls, verrucose, warts medium to large, without germ pore, with plage not very evident, with suprahilar depression, orange-brown in KOH, dextrinoid, non-metachromatic. *Basidia* 30 – 37 x 6 – 8 µm, clavate, rarely with slight central constriction, tetraspored, hyaline or yellowish, sterigmata 2 – 5 µm long. *Pleurocystidia* not observed. *Cheilocystidia* 20.8 – 31 x 5.6 – 8 µm, apex 3.6 – 7 µm diam., lageniform, lecythiform, tibiiform, with subcapitate or capitate, rarely with obtuse apex, hyaline or yellowish. *Subhymenium* cellular. *Hymenophoral trama* subparallel. *Pileus trama* radial, hyphae 4 – 15.2 µm diam., thin-walled, hyaline or yellowish. *Pileipellis* a cutis, hyphae 3.2 – 16 µm diam., prostrate, thin-walled, hyaline or yellowish, without encrusted pigment. *Pileocystidia* absent. *Caulocystidia* 24 – 52 x 4.8 – 23.2 µm, lageniform, cylindrical, flexuose, narrowly clavate, with obtuse, or subcapitate to capitate (4.4 – 12 µm diam.) apex, hyaline or yellowish, in tufts or palisade, only at the stipe apex. *Clamp connections* present, in the pileus trama, subhymenium and stipe hyphae. A yellow pigment dissolves when lamellae are mounted in KOH.

KOH on dry pileus: orange-red.

Type: USA, Michigan, Washtenaw Co., Ann Arbor, on hardwood, October 25, 1961, *A. H. Smith 64755* (MICH).

I was not able to observe pleurocystidia, described by Hesler (1969) as ventricose; maybe the structures observed by him were basidioles. Hesler (1969) distinguished this species from *G. spectabilis* by its whitish stipe and bigger spores, (8.5 –) 9 – 13 x (5 –) 6 – 7.5 µm; however, the stipe in dry condition is yellowish and the spores of the type are smaller. Hesler recorded the trama "of loosely interwoven broad hyphae". It seems that in specimens with very thick context, sometimes it is difficult to observe the true disposition of the hyphae. The type of *G. subspectabilis* is closely related to *G. junonius* and *G. spectabilis,* and is identical to *G. armillatus*, except for the pleurocystidia that are rare in *G. armillatus.* I propose *G. subspectabilis* as a synonym of ***G. armillatus*** (but see discussion under this species).



Figs. 66 – 70. 66: *Gymnopilus rufosquamulosus*, cellular subhymenium. 67 – 68: *G. subearlei*, 67: cellular subhymenium, 68: thick-walled hyphae from hymenophoral trama. 69: *G. subpurpuratus*, ramose subhymenium. 70: *G. subspectabilis*, radial pileus trama. Scale bar = 10 µm.

Gymnopilus tuxtlensis Guzm.-Dáv., Mycotaxon 50: 345, 1994 (as "*tuxtlense*").

Fig. 58, 64
Basidiospores 7.2 – 8.4 (– 9.6) x 4.8 – 5.6 µm, Q = 1.38 – 1.58 (– 1.61)(– 1.71), ellipsoid, rarely oblong, with short truncate, subacute or obtuse apex, slightly thickened walls, verrucose, warts medium to large, without germ pore, with plage, with a slight suprahilar depression, orange-brown in KOH, dextrinoid, non metachromatic. *Subhymenium* cellular. *Clamp connections* present, in the pileipellis and subhymenium hyphae.

Type: Mexico, Veracruz, road Catemaco to Montepío, Estación Biológica de Los Tuxtlas de la UNAM, July 26, 1981, *G. Guzmán 19671* (XAL).

KOH on dry pileus: dark orange-red.

This species is very easy to distinguish from others because of the yellowish and small basidiomata, the tropical habitat and the large and distinctive pleurocystidia.

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PLEUROTUS ARAUCARIICOLA IS PLEUROTUS PULMONARIUS

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Abstract: Specimens of *Pleurotus* growing on *Araucaria angustifolia* were collected, macro- and microscopically described and compared with the type of *Pleurotus araucariicola* which was collected by Singer in the same area and on the same substrate fifty years ago. Interspecific mating tests were carried out making crossings with *P. albidus*, *P. pulmonarius* and *P. ostreatus*. The morphological studies and the mating tests allowed us to conclude that *P. araucariicola* is a later synonym of *P. pulmonarius*.

Keywords: Systematics, mating tests, Pleurotaceae, *Araucaria*

INTRODUCTION

In 1953 Rolf Singer collected some interesting specimens of *Pleurotus* growing on dead trunks of *Araucaria angustifolia* (Bertol.) Kuntze (= *A. brasiliana* A. Rich) in the rain forest of southern Brazil, near the Argentine border. He considered that these specimens belonged to a new species which he named *P. araucariicola* Singer (Singer 1953).

Araucaria angustifolia is a tree known as "Paraná pine" which grows in the tropical mixed rain forest mainly in the south of Brazil (States of Paraná, Santa Catarina and Rio Grande do Sul,) and in the northeast of Argentina (province of Misiones). This area has a mild to hot summer without a dry season. The trees grow at an altitude between 600 – 2300 m and can descend to lower altitudes (FAO, 1986). It grows best along the border between forest and grassland. The area occupied by the *Araucaria* forest is about 200.000 km^2, but dwindling due to over exploitation, extending from parallel 29° 30' Lat S. to parallel 20° Lat. S (Catelli Piccolo, 2002). "Paraná pine" is the most important timber species in Brazil due to the many uses of its wood and pulp (Varty, 1996). From the Mycological point of view, it is an interesting substrate, since only a few species of Agaricales have been described growing on *Araucaria* wood (Lechner *et al.*, 2002).

In 2001, the two latter authors traveled to Misiones (Argentina), near the Brazilian border and made a field trip around the *Aracauria angustifolia* forest in search of *P. arucariicola*. Three collections were obtained which were macro- and microscopically described and compared with the holotype of *P. araucariicola*.

MATERIALS AND METHODS

Macro- and micromorphological description: Specimens were macro- and microscopically described. Colour names are in accordance with Munsell (1954). Citation of author names of taxa is according to Kirk & Ansell (1992). Herbarium

abbreviations follow Holmgren *et al.* (1990). Specimens are deposited in the BAFC and TENN Mycological Herbaria. Cultures were deposited in the three culture collections of the Institutions mencioned above (BAFC: culture collection of the Department of Biological Sciences of the Facultad de Ciencias Exactas y Naturales, University of Buenos Aires; UT: Collection of cultures of the Department of Botany, University of Tennessee and ICFC: IIB-INTECH collection of fungal cultures). For microscopic examination, sections were mounted in 5% KOH and 1 % aqueous phloxine.

Cultures used:

Pleurotus aff. *araucariicola* (PMI1). ARGENTINA, Misiones, Parque Municipal La Araucaria, growing on dead branch of *Araucaria angustifolia*, 27-V-2001. Leg. E. Albertó & O. Popoff (ICFC 445/01, BAFC 76).

Pleurotus aff. *araucariicola* (PMI2). ARGENTINA, Misiones, Parque Municipal La Araucaria, growing on dead branch of *A. angustifolia*, 27-V-2001. Leg. E. Albertó & O. Popoff (TENN 10775, ICFC 432/01, BAFC 263)

Pleurotus aff. *araucariicola* (PMI3). ARGENTINA, Misiones, Parque Municipal La Araucaria, growing on dead branch of *A. angustifolia*, 27-V-2001. Leg. D. Krugher (TENN 10774, ICFC 433/01, BAFC 213).

Pleurotus pulmonarius (PULM). ARGENTINA, Buenos Aires, Ezeiza, on trunk of *Populus nigra,* 25/VII/87, Leg. J. Deschamps (BAFC 1003, ICFC 29/99).

Pleurotus ostreatus (OSTR). ITALY, Commercial strain, IX/93. Leg. E. Albertó. (BAFC 2067, ICFC 42/99).

Pleurotus albidus (ALB). ARGENTINA, Buenos Aires, Llavallol, Sta. Catalina. Growing on dead wood. 06/IV/99. Leg. E. Albertó & B. Lechner (BAFC 1350), ICFC 75/99).

Fruit body production: New fruitbodies were obtained following traditional methods for fruiting *Pleurotus* species (Zadrazil, 1974; Stamets 1993). A mixture of willow sawdust , *Salix* sp., (70 %), wheat meal (10 %), oatmeal (4 %) and $CaCO_3$ (1 %) was introduced into polypropylene bags and autoclaved at 120 °C for 2 hours. Bags were inoculated with strains ICFC 445/01, TENN 10775 and TENN 10774, and incubated in the dark at 25°C for 15 days. Bags were kept at 20-22 °C with 9 h light/ 15 h darkness photoperiod to induce fruit body formation. The specimens were used to obtein spore prints and for the macro- and micromorphology study.

Mating studies: Monosporic cultures were obtained from water dilutions of fresh spore prints on sterile aluminum paper; spores were suspended in 10 ml of sterile-distilled water containing 0.01 ml Tween 80 to avoid agglutination. This solution was diluted to 1/10, 1/100 and 1/1000. Petri dishes containing Nobles' medium (Nobles, 1948) were inoculated with 1 ml of each of these dilutions and incubated in the dark at 25°C. Colonies were reisolated in tubes, discarding all those having clamps. Haplonts were confronted in pairs in Petri dishes using 7-mm diam blocks as inoculum. Plates were incubated in the dark at 25°C, and after a week hyphae were observed under the microscope both in the contact zone and in the lateral area (Burnett, 1968). A positive result was reckoned (+) by the presence of clamps, and a negative one (-) by their absence. Self-crossing tests were done in order to obtain mating types. Interspecific pairings were later carried out using the monosporic test strains of *Pleurotus ostreatus* (OSTR) BAFC 2067, *P. albidus* (ALB) ICFC 75/99 and *P. pulmonarius* (PULM) BAFC 1003.

RESULTS

Pleurotus araucariicola Singer, Lilloa 26: 141. 1953.

Pileus 21-30 x 14-20 mm, flabelliform, reddish brown (5YR 5/4) to dark brown (7,5 YR 5/8), dorsiventraly applanate, surface smooth, glabrous. Lamellae decurrent, crowded, 2-3 mm wide, reddish brown (YR 5/4), margin entire. Stem 2 mm long and 3.5 mm diam., eccentric to lateral, smooth, to sessile. Flesh thin, less than 2 mm thick, corky.

Spores 6.7-(8.3)-9.8 x 2.6-(3.2)-3.6 µm Q= 2.6, n= 15, cylindric-oblong, hyaline, thin-walled, non amyloid (IKI^-). Basidia 21-26 x 5-5.5 µm, club-shaped, 4-spored. Cheilocystidia absent. Numerous basidioles or pleurocystidia present 23-30 x 5-6 µm. Hymenophoral trama irregular to subparallel, with sclerified clamped hyphae (5.2-10.4 µm diam.) and thin walled hyphae (2.5-10.4 µm diam.); no oleiferous hyphae were observed. Context with generative thin- and thick-walled hyphae (4.7-10.4 µm diam.). Stem with thick walled generative hyphae 3.1- 7.3 µm diam. Pileipellis in a cutis 20-40 µm thick not highly differentiated, with radially parallel generative hyphae.

Remarks: The type is represented by three basidiomata, which are in bad state of conservation. Based on the general aspect and the brownish colour of the pileus we may infer that it may have been dried by a strong heat treatment. Measures are those of dried material, only one stem could be measured since one specimen was sessile and in the other the stem was missing.

Material studied: BRASIL, Río Grande do Soul, Serra Itaimbezinho 29° 50,5′; Leg. R. Singer B89, 05-XI-1951, BAFC 51.061 (HOLOTYPE).

Description of specimens of *Pleurotus* collected in the *Araucaria* forest.

Pileus 27-30 x 15-17 mm, flabelliform, whitish to greyish (5Y 6/1 to 5Y 7/1, 5Y 7/2), very pale brown when dry (10YR 8/4), surface smooth, glabrous, shiny, gelatinous. Lamellae decurrent, crowded, 2-3 mm wide, concolorous with the pileus, yellow with a margin in dry state (10YR 8/6), margin entire. Stem 2-10 mm long and 2-6 mm diam., short, eccentric to lateral, smooth. Flesh thin, 2-5 mm thick; when dry less than 1 mm, corky.

Spores 8.3-(9.4)-10.9 x 2.6-(3.4)-3.6 μm Q= 2.8, n= 15, cylindric-oblong, hyaline, thin-walled, IKI^-. Basidia 24-26 x 4.1-5.2 μm, club-shaped, 4-spored. Cheilocystidia absent. Numerous basidioles or pleurocystidia present 23-30 x 5-6 μm. Hymenophoral trama irregular, with sclerified clamped hyphae (5.2-7.8 μm diam.) and thin-walled hyphae (3.5-10.4 μm); no oleiferous hyphae were observed. Context with generative, thin- and thick-walled hyphae, 4.2-10.4 μm diam. Stem with thick-walled generative hyphae 3.6- 6.3 μm diam. Pileipellis in a cutis 20-40 μm thick, not highly differentiated, with radially parallel generative hyphae.

Material studied: ARGENTINA, Misiones, La Araucaria Park, SL 26° 32', WL 54° 04', growing on branch of *Araucaria angustifolia*, *E. Albertó & O. Popoff*, 27-V-2001, BAFC 51.090; Misiones, La Araucaria Park, (same location) growing on *A. angustifolia*, *E. Albertó & O. Popoff*, 27-V-2001, BAFC 51.089, TENN 58.981; Misiones, La Araucaria Park, growing on *A. angustifolia*, *D. Krugher*, 27-V-2001, BAFC 51.091, TENN 58.980.

Self-crossing of P. araucariicola (PMI1)

Pairing of 9 monosporic cultures in all combinations revealed a tetrapolar mating system. Finally, isolates 6 and 10 were assigned mating type A_1B_1; isolates 4 and 5 were A_1B_2; isolates 1, 2 and 9 were A_2B_1; isolates 11 and 15 were A_2B_2 (Fig. 1).

Interespecific pairings

Pairings of monosporics 6 (A_1B_1), 4 (A_1B_2), 2 (A_2B_1) and 11 (A_2B_2) of *Pleurotus* aff. *araucariicola* from Misiones (PMI1) X 4 mating types of test strains of *Pleurotus pulmonarius* (PULM), *P. albidus* (ALB) and *P. ostreatus* (OSTR) were carried out. The results of pairings show that PMI1 is compatible with PULM but it is not compatible with *P. ostreatus* and *P. albidus*. Two other strains of *P.* aff. *araucariicola* (PMI2 and PMI3) were crossed and resulted also compatible with PMI1 (Fig. 2).

	1	2	9	4	5	11	15	6	10
1									
2	-								
9	-	-							
4	+	+	+						
5	+	+	+	-					
11	-	-	-	-	-				
15	-	-	-	-	-	-			
6	-	-	-	-	-	+	+		
10	-	-	-	-	-	+	+	-	

Fig. 1. Self-crossing grid for *Pleurotus* aff. *araucariicola* from Misiones (PMI1): +, pairing compatible; -, pairing incompatible.

PULM

PMI1	1	6	7	3
4	+			
2		+		
6			+	
11				+

OSTR

PMI1	4	10	11	7
4	-			
2		-		
6			-	
11				-

ALB

PMI1	5	7	18	10
4	-			
2		-		
6			-	
11				-

PMI2

PMI1	1	6	7	3
4	+			
2		+		
6			+	
11				+

PMI3

PMI1	9	11	13	12
4	+			
2		+		
6			+	
11				+

Fig. 2. Interspecific Pairing Tests. PMI1: *Pleurotus aff. araucariicola* from Misiones; OSTR: Test strain of *P. ostreatus*; PULM: Test strain of *P. pulmonarius*, ALB: Test strain of *P. albidus;* PMI2 and PM3, strains of *Pleurotus aff. araucariicola* from Misiones; + paring compatible; -, paring incompatible.

DISCUSSION AND CONCLUSION

When we compared the morphology of the specimens of *Pleurotus* aff. *araucariicola* with the type material we observed that all specimens were very similar. *P.* aff *araucariicola* has a relatively small pileus 27-30 x 15-17 mm, short stem 2-10 x 2-6 mm, spores 8.3-10.9 x 2.6-3.6 µm; *P. araucariicola* (type material) has a pileus of 21-30 x 14-20 mm, stem 2 x 3.5 mm and spores 6.7-9.8 x 2.6-3.6 µm. On the basis of the macro- and microscopic studies we concluded that all specimens belonged to the same species.

The macro- and micromorphology studies showed that the specimens were very similar to *P. ostreatus* (Jacq.: Fr.) Kummer and *P. pulmonarius* (Fr.) Quélet. Singer, in the diagnosis of the type of *P. araucariicola* pointed out that "this species, which is closest to *P. ostreatus*, differed from it by the colour of the lamellae and several smaller characters". At present it is shared knowledge that colour of the fruitbody, among another characters (length of stem, diameter of cap, etc) may vary due to light, CO_2 and temperature received during the development of the fruitbody (Kalberer, 1974); as a consequence, macro-morphological studies are not sufficient for taxonomy in *Pleurotus* and must be complemented with mating or molecular studies (Petersen 1995, 1996).

Strains of *P. pulmonarius*, *P. ostreatus* and *P. albidus* were selected to carry out interespecific mating tests. The two former because it is impossible to recognize both species based only on morphology studies (Lechner *et al.* 2002); and the latter because it is present in the same area (Albertó *et al.* 2002).

The results of matings revealed that all of the three collection *P.* aff *araucariicola* were compatible with *P. pulmonarius* and incompatible with *P. ostreatus* and *P. albidus*.

Based on the above features we concluded that *P. araucariicola* is a later synonym of *P. pulmonarius*.

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RESURRECTION OF BLISTUM TOMENTOSUM AND ITS EXCLUSION FROM POLYCEPHALOMYCES (HYPHOMYCETES, DEUTEROMYCOTA) BASED ON 28S RDNA SEQUENCE DATA

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ABSTRACT

Members of the form genus *Polycephalomyces* (Hyphomycetes, Deuteromycota) were morphologically and phylogenetically evaluated. The aberrant taxon *P. tomentosus* was earlier placed in *Blistum*, for which it was the type. *Blistum* was distinguished from other Hyphomycetes on the production of white synnemata, ornamented cells along the synnemous stipe, viscous conidial mass at synnemous apex and a myxomyceticolous habit. Observations of *Polycephalomyces* species revealed that *P. tomentosus* can be distinguished from other species in the genus by its myxomyceticolous habit, verrucose ornamented cells along the synnemous stipe, and production of conidia that are variable in size (2.4-7.6 x 1.6-3.2 µm) and shape (ovoid, broadly fusiform and subglobose). Phylogenetic analyses of 28S rDNA excluded *P. tomentosus* from the clade containing all other *Polycephalomyces* species, thus making the genus paraphyletic. However, all *Polycephalomyces* species were recovered in the Clavicipitaceae clade when analyzed using either Hypocreaceae or Nectriaceae as outgroups. Therefore, we have segregated *P. tomentosus* from *Polycephalomyces* and again classified it n the monotypic genus *Blistum*.

Keywords: *Berkelella*, Clavicipitaceae, *Cordyceps*

INTRODUCTION

Kobayasi (1941) created *Polycephalomyces* to include *Stilbella*-like fungi with highly branched synnemata. Seifert (1985), in the most complete treatment of *Polycephalomyces* to date, included phialide shape, conidiophore branching, and conidial size as distinguishing characters of *Polycephalomyces* from *Stilbella* Lindau. Species in *Polycephalomyces* are synnematous (conidioma composed of fused erect conidiophores), have awl-shaped phialides, and produce single-celled conidia in a viscous matrix at the apex of the synnema. Seifert (1985) accepted four species in the genus (the type species *P. formosus* Kobayasi, *P. ramosus* (Peck) Mains, *P. cylindrosporus* Samson & H.C. Evans, and *P. tomentosus* (Schrader) Seifert). *Polycephalomyces ramosus* is distinguished from *P. formosus* based on production of beta (ß) conidia along the stipe of its synnema. The production of cylindrical spores in the viscous mass atop the synnema distinguishes *P. cylindrosporus*. Seifert (1985) reduced *P. paludosus* Mains to synonymy with *P. ramosus* and transferred *Blistum tomentosum* (Schrader) B. Sutton to *Polycephalomyces*. *Polycephalomyces tomentosus* is distinguished by the production of ornamented cells along the synnemous stipe, conidial size and shape, and its association with slime molds. All other species of *Polycephalomyces* have been associated with insects or entomopathogenic fungi. The aim of this study was to clarify the taxonomic placement of *Polycephalomyces tomentosus* through the use of morphological observations and phylogenetic analyses of 28S rDNA (large subunit ribosomal DNA).

Sutton (1973) traced the convoluted taxonomic history of *P. tomentosus*. The species was originally placed in *Stilbum* Tode by Fries (1832). Later, *P. tomentosus* was placed in *Tilachlidium* Preuss (Lindau 1908) and *Stilbella* (Bresadola 1903). However, *Stilbum* is now accepted as a generic name of Basidiomycota (Sutton 1973). Based on the *Acremonium*-like characteristics of *Tilachlidium*, as described in a revision of the genus by Gams (1971), *P. tomentosus* should not be included in *Tilachlidium*. In addition, the smooth synnemous stipe of *Stilbella erythrocephala* (Ditm.) Lindau (the lectotype of *Stilbella*) was enough to exclude *P. tomentosus* from this genus. Therefore, Sutton (1973) created the genus *Blistum* Sutton, which includes synnematous fungi that are creamy white with a capitate apex and ornamented cells along the stipe. The genus was typified by *B. tomentosum* (Schrader) Sutton. He also elevated *Stilbum tomentosum* var. *ovalisporum* A.L. Smith to *B. ovalisporum* (A.L. Smith) Sutton. *Blistum tomentosum* and *B. ovalisporum* were distinguished on the basis of conidial sizes and shapes. However, Seifert (1985) observed variability in conidial size and shape on some collections of *Stilbum tomentosum* and determined these characters to be polymorphic within each species and synonymized *B. ovalisporum* with *B. tomentosum* (as *Polycephalomyces tomentosus*).

Polycephalomyces tomentosus has been linked to two myxomyceticolous fungi, *Berkelella stilbigera* (Berk. & Br.) Sacc. (Clavicipitaceae, Hypocreales; Rossman et al. 1999) and *Nectria hirsuta* Samuels (Nectriaceae, Hypocreales; Samuels 1973). However such anamorph-teleomorph connections have not been confirmed, and the connections are suggested only by their physical associations (Seifert 1985).

The nutritional relationships of *Polycephalomyces* species to their host substrates also remain unclear. *Polycephalomyces formosus* (= *Stilbella barnesii* Kobayasi, *nom. inval.* = *S. falcata* Kobayasi, *nom. inval.*) has been considered the anamorph of *Cordyceps barnesii* Thwaites and *C. falcata* Berk. based on its association with these teleomorphs in nature (Massee 1895; Kobayasi 1941). However, Samson and Evans (1985) considered *P. formosus* to be a hyperparasite of *C. cantharelloides* Samson & Evans. In a similar manner, Petch (1924, 1933) suggested that *P. ramosus* (Peck) Mains, as *Stilbella setiformis* (Vahl.) Petch, was the anamorph of *C. barnesii* and *C. entomorrhiza* (Dicks.) Fries. Later, Petch (1938) concluded that it was a hyperparasite of *C. entomorrhiza*. Samson et al. (1984) found *P. ramosus* (as *Stilbella kervillei* Samson, Rombach & Seifert) on a troglobiotic dipteran along with *Hirsutella guignardii* (Maheu) Samson, Rombach & Seifert and considered *P. ramosus* a hyperparasite of *H. guignardii*. Samson et al. (1981) reported *P. cylindrosporus* Samson & Evans was found associated with a hemipteran, hymenopteran, and a coleopteran. Despite the attention given to *Polycephalomyces* it remains unclear whether it is either an anamorph of genus *Cordyceps* (Fr.) Link or a mycoparasite of the same genus.

MATERIALS AND METHODS

Cultures — Cultures of *Polycephalomyces formosus* (ARSEF 1424) and *P. tomentosus* (ARSEF 5353) were supplied by the United States Department of Agriculture, Agricultural Research Service, United States Plant, Soil, and Nutrition Laboratory, Tower Rd., Ithaca, New York 14853. Isolations of *P. ramosus* were from a collection of an unidentified lepidopteran larva made by J.F. White, Jr. and G.F. Bills near Xalapa, Mexico (August 1999). A voucher isolation was deposited into the ARSEF collection under number 7095. The voucher specimen for *P. ramosus* was deposited in the Rutgers Mycological Herbarium (RUTPP). Isolations were grown on Potato Dextrose Agar (PDA) at approximately 21°C for a minimum of 1 month. Strains received diffuse light.

Sequence data and analysis — DNA amplification and sequencing followed the protocol of Sullivan et al. (2001). Sequences were combined and initially aligned using ClustalX (Thompson et al. 1997). Alignment adjustments were made manually using Microsoft Word. Ambiguous regions were delimited and placed in brackets to prevent their use in the analysis. The alignment is available at *www.rci.rutgers.edu/~struwe/dnadata.htm*.

Maximum parsimony analyses were performed using PAUP version 4.0b10 for PPC (Swofford 2002). Heuristic tree searches were done using 1000 random sequence additions (saving a maximum of 500 trees), tree bisection-reconnection branch swapping algorithm and treating gaps as missing data. Jackknife analysis was performed to estimate support for the internal branches within the resulting trees. These analyses were performed with 100 replicates and 37% deletion per replicate (Farris et al. 1996). In addition, a topological constraint was applied in a separate analysis to impose the monophyly of *Polycephalomyces formosus*, *P. ramosus*, and *P. tomentosus*. The trees from the different analyses were compared with the K-H test (Kishino and Hasegawa 1989) using PAUP version 4.0b10. PAUP was also used to calculate Consistency Index (CI) and Retention Index (RI) values.

Taxa selection — Sequences obtained from GenBank as well as three new sequences obtained for this study are listed in Table 1. Taxa included in this study were selected due to the taxonomic and host substrate diversity that they provide. Separate parsimony and jackknife analyses were performed with two different outgroups to test the family affinity of *Polycephalomyces tomentosus*. The first outgroup included Nectriaceae: *Nectria cosmariospora*, *N. vilior*, and *Nectriopsis squamulosa* (Fig 1). The second outgroup included Hypocreaceae: *Hypocrea lutea*, *Hypomyces chrysospermus*, and *Hypomyces tremellicola* (tree not shown; jackknife values reported in Fig 1).

Morphological observations — Microscopic observations of *Polycephalomyces formosus*, *P. tomentosus*, and *P. ramosus* were made with the use of a Zeiss compound light microscope from squash mounts of synnemata and conidiophores from cultured strains on PDA. Additional observations were made from the voucher specimens of *P. ramosus* and *P. tomentosus* (Coll. by K. Hodge *s.n.*, Sept. 2002, RUTPP). Conidial measurements were made from cultured strains and are the ranges of 20 conidia from each *Polycephalomyces* species. Photographs were taken of cultured strains of *Polycephalomyces* with a Nikon Coolpix 880 digital camera (Nikon Corp.).

Table 1. GenBank accession number for sequences compared here. *Polycephalomyces* sequences newly obtained for this study are marked by an asterisk (*).

Taxa	Genbank accession numbers
Atkinsonella hypoxylon (Pk.) Diehl	U57087
Balansia strangulans (Mont.) Diehl	U57679
Claviceps purpurea (Fr.) Tul.	U57085
Cordycepioideus bisporus Stifler	AF009654
Cordyceps capitata (Fr.) Link	U57086
Cordyceps khaoyaiensis Hywel-Jones	AF327375
Cordyceps militaris (L.) Link	AF043135
Cordyceps ophioglossoides (Ehrenberg) Link	U47827
Cordyceps prolifica Kobayasi	AB027370
Cordyceps pruinosa Petch	AB044635
Cordyceps subsessilis Petch	AF373285
Cordyceps takaomontana Kobayasi	AB044637
Cordyceps tuberculata (Lebert) Maire	AF327384
Epichloë typhina (Pers.:Fr.) Tul.	U17396
Hyperdermium bertonii (Speg.) White et al.	AF242354
Hypocrea lutea (Tode) Petch	AB027384
Hypomyces chrysospermus Tul.	AB027385
Hypomyces tremellicola (Ellis & Everh.) Rogerson	U17427
Myriogenospora atramentosa (Berk & Curt.) Diehl	U57084
Nectria cosmariospora Ces. & De Not.	U17407
Nectria vilior Starbäck	U57348
Nectriopsis squamulosa (Ellis) Samuels	U17423
Polycephalomyces formosus Kobayasi*	AY259544
Polycephalomyces ramosus (Peck) Mains*	AY259543
Polycephalomyces tomentosus (Schrader) Seifert*	AY259545
Torrubiella luteorostrata Zimm.	AF327388

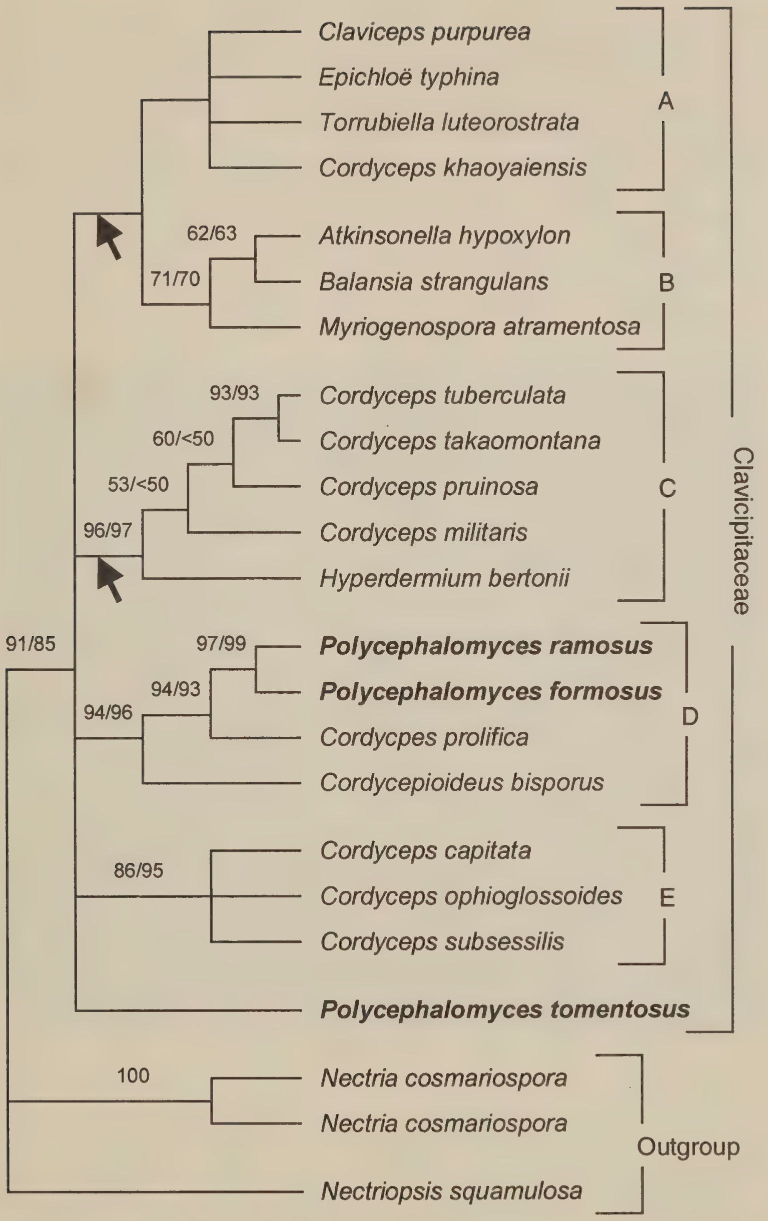
RESULTS

Phylogenetic relationships — Both the first parsimony analysis, with Nectriaceae as the outgroup, and the second parsimony analysis, with Hypocreaceae as the outgroup, contained 886 characters in which 95 (10.7%) were informative. Analysis 1 (outgroup Nectriaceae) resulted in two most-parsimonious trees (length = 386; CI = 0.544; RI = 0.583; Fig. 1). Analysis 2 (outgroup Hypocreaceae) resulted in four most parsimonious trees (length = 402; CI = 0.530; RI = 0.551; results not shown). In the strict concensus trees of Analyses 1 and 2 all members of the ingroup grouped together in the Clavicipitaceae clade (Fig 1) with jackknife values of 91% in Analysis 1 and 85% in Analysis 2. Five main clades (Clades A, B, C, D, E; Fig 1) were found in Analyses 1 and 2, with each clade including identical taxa in both analyses. *Polycephalomyces tomentosus* was the only species not to group with any other taxon in both analyses.

The only topological differences found within the Clavicipitaceae clade between Analysis 1 and Analysis 2 were found in clades A, C, and E. Clade A formed a polytomy in Analysis 1. Clade A in Analysis 2, *Torrubiella luteorostrata* and *Cordyceps khaoyaiensis* formed a sister group and were basally connected to *Epichlöe typhina*, followed by *Claviceps purpurea*. In clade C the nodes linking *Cordyceps pruinosa* Petch, *C. militaris,* and *Hyperdermium bertonii* in Analysis 1 collapsed in Analysis 2. Clade E contained an additional bifurcation, grouping *C. ophioglossoides* and *C. subsessilis* together in Analysis 2. Clade D included *Polycephalomyces formosus*, *P. ramosus*, *Cordyceps prolifica* and *Cordycepioideus bisporus* in both analyses. *Polycephalomyces formosus* and *P. ramosus* grouped together (jackknife values 97% and 99%, respectively). These taxa were basally connected to *C. prolifica* (jackknife values 93% and 94%, respectively) and followed by *Cordycepioideus bisporus* (jackknife values 94% and 96%, respectively). *Polycephalomyces tomentosus* was the only unresolved species in the Clavicipitaceae clade in either analysis. Jackknife values above 50% from Analyses 1 and 2 are indicated in Fig. 1 on the branches.

The constrained analysis to evaluate the monophyly of *Polycephalomyces* with Nectriaceae as the outgroup produced six most-parsimonious trees (not shown) that were seven steps longer than the unconstrained trees. This hypothesized monophyly was not rejected by the K-H test in any of the six constrained trees (P = 0.0896 – 0.2089). The constrained analysis to evaluate the monophyly of *Polycephalomyces* with Hypocreaceae as the outgroup produced nine most parsimonious trees that were ten steps longer than the unconstrained trees. This hypothesized monophyly was rejected by the K-H test in two trees (P = 0.0253 and 0.0253) but not rejected in the other seven trees (P = 0.0587 – 0.1139).

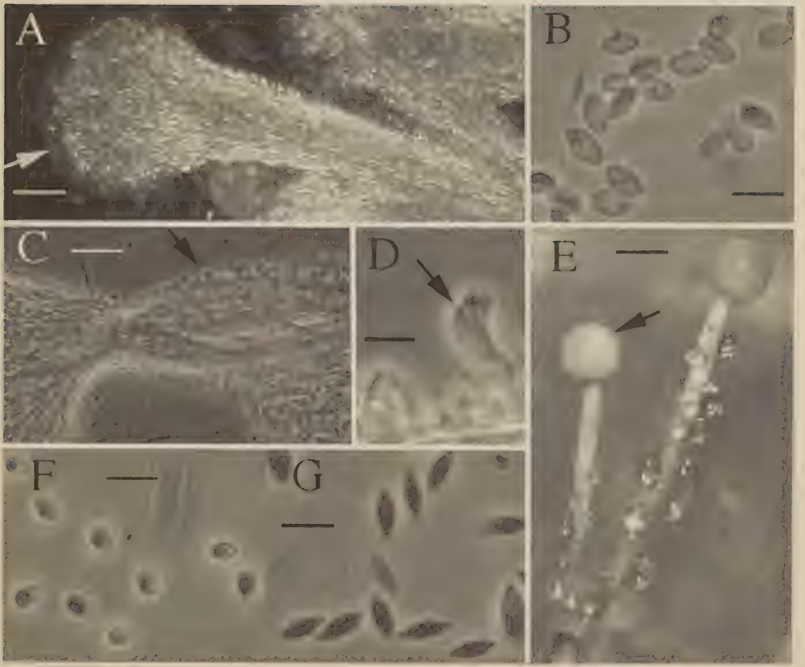
Fig. 1. A strict consensus of the two most-parsimonious trees from Analysis 1 (length = 386; CI = 0.544; RI = 0.583). Jackknife values are indicated on the internode before the node they represent. The first jackknife value was recovered from Analysis 1. The second jackknife value was recovered from Analysis 2 (tree not shown). Arrows indicate alternative locations the *Polycephalomyces tomentosus* branch was connected to in each of the most-parsimonious trees.


Claviceps purpurea
Epichloë typhina
Torrubiella luteorostrata
Cordyceps khaoyaiensis
A
62/63
71/70
Atkinsonella hypoxylon
Balansia strangulans
Myriogenospora atramentosa
B
93/93
60/<50
53/<50
96/97
Cordyceps tuberculata
Cordyceps takaomontana
Cordyceps pruinosa
Cordyceps militaris
Hyperdermium bertonii
C
Clavicipitaceae
91/85
97/99
94/93
94/96
Polycephalomyces ramosus
Polycephalomyces formosus
Cordycpes prolifica
Cordycepioideus bisporus
D
86/95
Cordyceps capitata
Cordyceps ophioglossoides
Cordyceps subsessilis
E
Polycephalomyces tomentosus
100
Nectria cosmariospora
Nectria cosmariospora
Nectriopsis squamulosa
Outgroup

Morphological data — *Polycephalomyces* species have determinate, sometimes branching, synnemata with hyaline, parallel hyphae running the length of the stipe. The synnemata terminate with phialides that produce masses of conidia in a viscous matrix. Observations of cultured specimens revealed that *P. formosus* and *P. ramosus* produced both α and β conidial states. However, β conidiophores and conidia (Fig. 2G) of *P. formosus* were produced only on the mycelial layer that formed along the surface of the agar. In cultures of *P. ramosus* the β conidia were found along the stipes of the synnemata as well as on surface mycelium of the colony. The α conidia (Fig. 2F) were found in droplets at the synnemous apex and in viscous pools located directly on the agar of some cultures of *P. formosus* and *P. ramosus*. The α conidia of *P. formosus* and *P. ramosus* were ovoid and 2.0-2.8 x 1.6-2.0 µm and2.4-3.2 x 1.6-2.4 µm in size, respectively (Fig. 2F; Table 2). The β conidia of *P. formosus* and *P. ramosus* were dry and produced in chains from phialides. The β conidia of *P. formosus* and *P. ramosus* were fusiform and 3.2-4.8 x 0.8-1.6 µm and 3.2-4.0 x 1.6-2.0 µm in size, respectively (Fig. 2G; Table 2). Ornamented cells (Fig. 2C, 2D) were observed along the synnematous stipes of the cultured isolates of *P. tomentosus* as described by Seifert (1985). Ornamented cells are subglobose to cylindrical, 4-9 x 3-6 µm, with wart-like projections. These ornamented cells were not observed in any other *Polycephalomyces* spp. in this study. The conidia of *P. tomentosus* in culture were ovoid, broadly fusiform, and size subglobose (Fig. 2B) and produced at the synnemous apex only (Fig. 2A; Table 2). The of these conidia were 2.4-7.6 x 1.6-3.2 µm (Table 2). No β conidia were produced by *P. tomentosus*.

Table 2. Conidial morphology of *Polycephalomyces* spp.

	alpha Conidia		*beta* Conidia	
Taxon	Size (µm)	Shape	Size (µm)	Shape
P. formosus	2.0-2.8 x 1.6-2.0	ovoid	3.2-4.8 x 0.8-1.6	fusiform
P. ramosus	2.4-3.2 x 1.6-2.4	ovoid	3.2-4.0 x 1.6-2.0	fusiform
P. tomentosus	2.4-7.6 x 1.6-3.2	subglobose-fusiform	None	None



Figs 2. A-D *Polycephalomyces tomentosus*. A. Synnema with apical conidiogenous cells (arrowhead). Bar = 30 µm. B. Variably shaped conidia. Bar = 4.5 µm. C. Stipe of synnema showing ornamented cells (arrowheads). Bar = 15 µm. D. Ornamented cells with wart-like feature (arrowhead). Bar = 5 µm. E-G *Polycephalomyces formosus*. E. Synnemata with viscous apex (arrowhead). Bar = 1400 µm. F. α conidia. Bar = 6.25 µm. G. β conidia. Bar = 4 µm.

DISCUSSION

Unconstrained phylogenetic analyses support the placement of *Polycephalomyces tomentosus* in Clavicipitaceae (Fig 1). This is consistent with the linkage of this species to the clavicipitalean *Berkelella stilbigera*. Conidial morphology, synnemous ornamentation, phylogenetic analyses and host substrate support exclusion of *P. tomentosus* from the genus *Polycephalomyces*. The removal of *P. tomentosus* from *Polycephalomyces* requires consideration of other possible generic relationships. Morphological and host substrate similarities exist with *Stilbella*. However, *Stilbella* contains only one myxomycete pathogen, *S. byssiseda* (Pers.) Seifert which does not have verrucose ornamented cells.

Of the four *Stilbella* species that do produce verrucose ornamented cells, (*S. aleuriata* (Berk. & Curtis) Seifert, *S. clavulata* (Mont.) Seifert, *S. aterrima* (Welw. & Curr.) Seifert and *S. bambusae* (Pat. & Gaill.) Seifert) three are found on tree bark while *S. bambusae* is found on dead bamboo culms (Seiftert 1985). In addition, all of these except *S. aterrima* (whose teleomorph remains unknown) have been linked to species of *Nectria* (Seiftert 1985). Since *P. tomentosus* is placed within Clavicipitaceae and has probable association with a clavicipitalean teleomorph, its inclusion in *Stilbella* cannot be supported.

Previously, *Polycephalomyces tomentosus* was transferred to *Dendrostilbella* Höhnel (von Höhnel 1916) and *Tilachlidium* Preuss (Lindau 1910). However, both of these transfers were based on misidentifications of *Stilbella byssiseda* as *P. tomentosus* (Seifert 1985). In addition, Dennis (1956) linked the type of *Dendrostilbella*, *D. prasinula* Höhnel, to the teleomorph *Claussenomyces prasinulus* (P. Karst.) Korf & Abawi (Helotiaceae, Helotiales). Members of *Dendrostilbella* do not contain species with ornamentation on the stipe (Seifert 1985). Thus, *Tilachlidium* and *Dendrostilbella* are not appropriate genera for placement of *P. tomentosus*. We propose to resurrect the monotypic genus *Blistum* and recognize *P. tomentosus* as *Blistum tomentosum* (Schrader) Sutton.

Taxonomy

Blistum tomentosum (Schrader) Sutton (Fig. 2A-D)

≡ *Stilbum tomentosum* Schrader, J. Bot. **2**:65 (1799) : Fries, Systema Mycologicum **3**:301 (1832)

≡ *Stilbella tomentosa* (Schrader ex Fr.) Bresadola, Annales Mycologici. **1**:129 (1903)

≡ *Tilachlidium tomentosum* (Schrader ex Fr.) Lindau, Rabenhorst's Kryptogamen Flora **1**:306 (1908)

≡ *Blistum tomentosum* (Schrader ex Fr.) B. Sutton, Mycological Papers **132**: 19 (1973)

≡ *Polycephalomyces tomentosus* (Schrader ex Fr.) Seifert, Studies in Mycology **27**: 175 (1985).

Description in culture: Synnemata cylindrical, capitate, rarely bifurcating, white 200-300 x 15-40 µm. Stipe composed of parallel hyphae and covered by verrucose ornamented cells. Verrucose cells subglobose to ellipsoidal, 2-5 x 3-7 µm, with globose wart-like ornamentation on surface. Conidial mass white, opaque, hemispherical. Conidia ovoid, broadly fusiform, subglobose, and all intermediates, 2.4-7.6 x 1.6-3.2 μm.

Habitat: Sporangia of Trichiaceae (Myxomycetes).

Distribution: Japan, Sri Lanka, France, Netherlands, Germany, England, Austria, United States (see Seifert 1985).

Host Substrates — The host specificities and teleomorphic linkages of species in *Polycephalomyces sensu stricto* is still uncertain. However, *P. formosus* and *P. ramosus* in the phylogenetic analyses grouped with entomopathogenic species from the genera *Cordyceps* and *Cordycepiodeus* and not with the mycoparasitic species *Cordyceps capitata* and *Cordyceps ophioglossoides*. These results suggest that *Polycephalomyces sensu stricto* has an entomopathogenic habit.

Importance of monophyly in genera of the Deuteromycota — The Deuteromycotina is a phenotypically assembled group that includes anamorphic (asexual) fungi. Thus, the phylogenetic placement and evolutionary relationships of anamorphs that have not been linked to a teleomorph (sexually reproductive) remain unrecognized. However, morphological characters of anamorphs have been shown to provide evidence when determining monophyly of fungal groups. Anamorphic morphological characters have been used to separate the often synonymized genera *Ceratocystis* Ellis & Halsted and *Ophiostoma* Syd. & P. Sydow. These genera, "which have essentially identical teleomorph morphologies," are now considered to belong to different orders (Seifert & Samuels 2000, pg. 14). Similarly, *Fusarium* Link (an anamorphic genus) species are used to identify the teleomorphic genus *Gibberella* Sacc. with certainty (Samuels et al., 2001). White et al. (2000), in a review of the graminicolous clavicipitaleans, demonstrated that anamorphic states corroborated the molecular phylogeny for three major clades. In this study, species of *Polycephalomyces sensu stricto* were shown to be monophyletic and suggest a linkage to the teleomorphic genus *Cordyceps*. These studies suggest that it is possible to gain insight into evolutionary relationships based on anamorphic morphological characters. With the inclusion of anamorphic, teleomorphic, and molecular character data it is feasible for fungal systematics to move to a unified, phylogenetically based nomenclature.

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THE LICHEN FAMILY PHYSCIACEAE (ASCOMYCOTA) IN CHINA VI. THE GENUS PYXINE

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ABSTRACT: A total of 11 species of *Pyxine* from China are recognized based on morphological, anatomical and chemical studies, of which *P. consocians*, *P. coralligera* and *P. meissnerina* are reported in China for the first time.

KEYWORDS: new records, *Pyxine consocians*, *Pyxine coralligera*, *Pyxine meissnerina*

Introduction

The genus *Pyxine* was established by Fries in 1825 with *Lecidea sorediata* Ach.(≡ *Pyxine sorediata*) as the type species. At present, about fifty species of this genus are known in the world according to the author's count, most of which are distributed in tropical and subtropical regions. The morphology, anatomy and chemistry of the genus *Pyxine* have been discussed in detail by lichenologists (Imshaug 1957, Swinscow & Krog 1975). Some regional revisions about the genus *Pyxine* have been made in North and Central America (Imshaug 1957), East Africa (Swinscow & Krog 1975), India (Awasthi 1982), Australia (Rogers 1986, Kalb 1994) and Brazil (Kalb 1987). However, Chinese species of *Pyxine* have not been revised although ten species have been reported (Wei 1991).

In the present study, we revised Chinese species of *Pyxine* based on specimens of the genus housed in HMAS-L and IFP, and Taiwan specimens loaned from TNS. The

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results show that the occurrence of *Pyxine berteriana*, *P. cocoes*, *P. copelandii*, *P. endochrysina*, *P. limbulata*, *P. philippina*, *P. sorediata* and *P. subcinerea* is confirmed in China. The following three species are new to China: *P. consocians*, *P. coralligera* and *P. meissnerina*. The occurrence of *P. microspora* and *P. petricola* previously reported (Hue 1900, Zahlbruckner 1930b, see Wei (1991)) are uncertain because specimens of the two species from China can not be traced. In addition, *Pyxine margaritacea* is only reported in Taiwan province and the related specimens are not available.

The specimens examined are housed in HMAS-L unless stated otherwise. Chemical constituents were identified by thin layer chromatography (Culberson 1972).

Key to the species of *Pyxine* in China

1. Thallus without soralia or isidia..2
1. Thallus with soralia or isidia..4
2. Thallus UV+, lichexanthone present..**1**. ***Pyxine beteriana***
2. Thallus UV-, lichexanthone absent..3
3. Medulla white to pale yellow, K+yellow→red， norstictic acid present..........**9**. ***Pyxine philippina***
3. Medulla yellow, K-, norstictic acid absent..**7**. ***Pyxine limbulata***
4. Thallus with soralia..5
4. Thallus with isidia..9
5. Thallus UV+, lichexanthone absent..6
5. Thallus UV-, lichexanthone present..7
6. Medulla white..**2**. ***Pyxine cocoes***
6. Medulla yellow..**11**. ***Pyxine subcinerea***
7. Soralia laminal, orbicular..**4**. ***Pyxine copelandii***
7. Soralia marginal, linear..8
8. Lobe with white pruina in patches covering large areas..........................**8**. ***Pyxine meissnerina***
8. Lobe without pruina or with pale pruina..**10**. ***Pyxine sorediata***
9. Medulla white to pale yellow..**3**. ***Pyxine consocians***
9. Medulla yellow..10
10. Isidia pustulate..**5**. ***Pyxine coralligera***
10. Isidia not pustulate..**6**. ***Pyxine endochrysina***

The Species

1. Pyxine berteriana (Fée) Imshaug, Trans. Am. Microsc. Soc. **56**: 254. (1957)
≡*Circinaria berteriana* Fée, Ess. Cryptog. Ecorc. Exot. Offic. 128 (1824).
=*Pyxine messneri* Tucker ex Nyl., Annls Sci. nat, Ser. 4, **11**: 255 (1859); *Pyxine cocoes* var. *meissneri* (Tucker ex Nyl.) Tucker, Proc. Am. Acad. **12**: 166 (1877).

Thallus foliose, yellowish grey, closely adnate to bark; lobes up to 1.5mm wide, mostly branching dichotomous, flat, little concave near the apices; white pruina on lobe tips, sometimes covering large areas in patches; pseudocyphellae white, marginal, linear; soredia, isidia and pustules absent. Medulla yellow to yellowish orange. Underside black, brown at the tips with black simple rhizines. Apothecia common, up to 1.0mm diameter, margin entire, usually black, devoid of algae, carbonized, but sometimes with thalloid exciple containing algae in young stage, epruinose; internal stipe colouress, K-; ascospores *Physcia* type, 20-22×6-8μm.

Chemistry: cortex UV+ yellow, K-; medulla K-, C-, PD-. TLC: lichexanthone and triterpenes.

Distribution. The present species has been reported in East Africa (Swinscow & Krog 1975), Australia (Rogers 1986, Kalb 1994) and Papua New Guinea (Kashiwadani 1977c). In China, it has been reported in Yunnan and Xizang provinces by Hue, A.Zahlbruckner, Wei & Jiang (Wei 1991). Now the range includes Sichuan and Hainan provinces.

Specimens examined: **Xizang**, Zhangmu, Wei & Chen 676; **Sichuan**, Mt. E'mei shan, Yu Wang 9449-1; **Yunnan**, Zhongdian, X. Y. Wang, J. J. Su & X. Xie, 5403; **Hainan**, Yuedong, Y. M. Jiang & S. Y. Guo, H-0716-1.

2. Pyxine cocoes (Sw.) Nyl., Mém. Soc. Imp. Sci. Nat. Cherbourg **5**: 108 (1857)
≡*Lichen cocoes* Sw., Nov. Gen. Sp. Pl. 146 (1788).

Thallus foliose, green to yellowish grey, adnate to bark, orbicular or irregular, up to 5.0cm in diameter; lobes up to 1.5mm wide, flat or little concave, round at the apices, pruina present on upper surface; pseudocyphellae marginal and occasionally laminal, not becoming reticulate; soralia marginal or laminal, sometimes extending to large areas; soredia granular. Medulla white. Underside black, brown at the tips, rhizines moderate, simple, black, short. Apothecia uncommon, up to 1.5mm in diameter, mature thalloid exciple often containing algal cells and appearing; internal stipe brown, K+ red. Spores *Physcia* type, 15.9-20.7×6.1-7.3μm.

Chemistry: cortex UV+ yellow, K-; medulla K-，C-，KC-，P-. TLC: lichexanthone.

Distribution. *Pyxine cocoes* is distributed widely in the tropical and subtropical areas. It has been reported from North America (Imshaug 1957), East Africa (Swinscow & Krog 1975), Papua New Guinea (Kashiwadani 1977c), Japan (Kasiwadani 1977b), India (Awasthi 1982) and Brazil (Kalb 1987). In China, the species has been reported in Sichuan, Yunnan, Hongkong and Taiwan (Wei 1991). Now it extends to Hainan province.

Specimens examined: **Hongkong**, S. L. Thrower 2531, **Yunnan**, Shiping county, J. D. Zhao & Y. B. Chen 2468a, **Hainan**, Yuedong County, J. B. Chen *et al.* 20800, 20801-1, Linshui County, J. B. Chen *et al.* 20485.

Discussion. *Pyxine cocoes* has a variable appearance, especially the form of the soralia. The soralia often initiate on cracked margins of lobes, but it is not uncommon that the soralia expand and cover large parts of the upper surface.

3. Pyxine consocians Vain., Philipp. J. Sci. **8**: 109 (1913).

Thallus foliose, yellowish grey, closely appressed to bark, orbicular or irregular, up to 5.0 cm in diameter, lobe less than 1.0mm in width, flat or concave, no pruina or little pruina on upper surface; pseudocyphellae mostly laminal, white and showing reticulate pattern, especially near tips of lobes; isidia scattered over the lobes, coralloid, simple or branched at the base, the apices of isidia often broken or pustulate, but never developing soredia. Medulla mainly white, and pale yellow in parts. Underside black, dark brown at the tips; rhizines the same color as the underside, simple or sometimes bifurcate at the end. Apothecia uncommon, 1.0mm in diameter, epruinose, margin black devoid of algae; ascospores *Physcia* or *Pachysporaria* type, 17.1-20×6-7μm.

Chemistry: cortex UV-, K+ yellow; medulla K+ dingy yellow→red, PD+ yellow→red. TLC: atranorin, norstictic acid, triterpenes and testacein (Rf Class 3, pink after spraying H_2SO_4 and heat).

Distribution. *Pyxine consocians* has been reported from East Africa (Swinscow & Krog 1975), Australia (Rogers 1986) and India (Awasthi 1982). It is new to China and distributed in Yunnan and Hainan provinces.

Specimens examined: **Yunnan**, Xishuangbanna county, J. B. Chen 6533, Yingjiang county, X. Y. Wang *et al*. 3128, **Hainan**, Linshui county, J. B. Chen *et al*. 20489, 20531-1, Yuedong county, Y. M. Jiang & S. Y. Guo H-0176-2.

Discussion. Awasthi (1981) reported the granular soredia derived from the pustulate apices of isidia based on the materials of *Pyxine consocians* from India, but the pustules on Chinese materials never develop into granular soredia. Testacein is the unknown substance reported by Swinscow & Krog (1975) and Kashiwadani (1977a), it is also present in *P. consocians*, *P. copelandii*, *P. coralligera* and *P. philippina* from China. The colors of medulla are variable in *P. consocians* from China. In two materials (20489 and 20531-1) from Hainan province, the medulla is distinctly yellow or orange in the upper parts and white in the lower parts, while two specimens (6533 and 3128) from Yunnan province and one (H-0716-2) from Hainan province have a white medulla. However, these materials have similar morphology and chemical ingredients. Moreover, they maybe live in the same ecological niche because they are all corticolous and collected in rain forests of South China. Therefore, there may be two populations in *P. consocians* from China.

4. Pyxine copelandii Vain., Philipp. J. Sci. **8**: 110 (1913)
=*Pyxine patellaris* Kurok., Bull. Nat. Sci. Mus., Tokyo **12**: 689 (1969).

Thallus foliose, pale yellowish brown; adnate to bark, orbicular or suborbicular, about 7.0 cm in diameter, lobes 0.5-1.2mm wide, linear, radiated, apices round, mostly branched, pale white pruina present on upper surface; pseudocyphellae marginal or laminal, linear to irregular; soralia laminal, orbicular, 1.5mm in diameter, soredia yellow or black-blue, granular or powdery. Medulla white to pale yellow. Underside black, rhizines sparse, simple and black. Apothecia not seen from Chinese materials.

Chemistry: cortex UV-, K+ yellow; medulla K+ yellow→red, C-, PD+ red. TLC: atranorin, norstictic acid, terpenes and testacein.

Distribution. *Pyxine copelandii* has been reported in east Africa (Swinscow & Krog 1975), Papua New Guinea (Kashiwadani 1977a) and Australia (Rogers 1986, Kalb 1994). In China, this species was only known in Taiwan province in the past, but now it extends to China's mainland.

Specimens examined: **Taiwan**, Pingdong, Y. Asahina 3678 (TNS), **Yunnan**, Xishuangbanna , J. B. Chen 5505.

Discussion. *Pyxine copelandii* was reduced as a synonym of *Pyxine retirugella* (Rogers 1986) and accepted by Kalb (1994) because they have similar morphology and chemical ingredients. However, Kalb (2000) has concluded that *P. copelandii* has patelliform soralia, whereas *P. retirugella* has polyisidangia; and the two should therefore be treated as distinct species.

5. Pyxine coralligera Malme, Bihang Kongl. Svenska Vetensk. Akad. Handl. **23**: 40 (1897).

Thallus foliose, yellow to yellowish to brown, loosely attached on bark, orbicular to irregular; lobes narrow, less than 1.2mm, mostly dichotomously branched; lobes flat, apices round; pseudocyphellae white, laminal, sometimes reticulate subapically; epruinose, isidia laminal, cylindrical, occasionally branched at the base, often becoming pustulate at apex, but not developing soredia. Medulla pale yellow to orange-yellow. Underside black, brown at the end of the lobes; rhizines moderate, black, simple. Apothecia not seen from Chinese materials.

Chemistry: cortex UV-, K+ yellow; medulla K-, C-, PD+ yellow→pale orange. TLC: atranorin, terpenes and testacein.

Distribution. *P. coralligera* has been known in East Africa (Swinscow & Krog 1975), Papua New Guinea (Kashiwadani 1977), India(Awasthi 1982) and Brazil (Kalb 1987). New to China.

Specimens examined: **Yunnan**, Xishuangbannan, J. B. Chen 5485, 5515.

Discussion. The description is based on one specimen (5485). This species is similar to *P. maculata*, but the latter has fine reticulate pseudocyphellae all over the lobes and lacks the teatacein. *P. coralligera* is also close to *P. consocians*, which differs from the former in the present of norstictic acid.

6. Pyxine endochrysina Nyl., Lich. Jap. 34 (1890).

Thallus foliose, yellowish grey to dark brown, loosely attached on rocks and bark, orbicular or suborbicular; lobe mostly dichotomously branched, up to 2.0mm wide, flat or somewhate concave, apices round; pruina present on upper surface, white, linear pseudocyphellae on margins, white; isidia laminal or marginal, black-blue, granular to subcylindrical, sometimes branched, apices often broken, but never becoming pustules. Medulla yellow. Underside black, pale brown at the tips; rhizines moderately dense, black, simple or sometimes branched at the end, 1-2mm long. Apothecia not seen on the specimens from China.

Chemistry: cortex UV-, K+ yellow; medulla K-, KC-, PD-. TLC: ±atranorin, zeorin and other terpenes.

Distribution. *Pyxine endochrysina* is distributed in tropical and subtropical region including East Africa (Swinscow and Krog 1975), Japan (Kashiwadani 1977b) and Australia (Kalb 1994) and is widespread in China.

Representative specimens examined: **Zhejiang**, Hangzhou city, J. D. Zhao & L. W. Xu 5010, Mt. Tianmu shan, J. D. Zhao & L. W. Xu 6379, 6393; **Hubei**, Wuchang city, J. D. Zhao & L. W. Xu 10409, 10417; **Hunan**, Mt. Hengshan, J. D. Zhao & L. W. Xu 9846,10016; **Anhui**, Mt. Huangshan, J. D. Zhao & L. W. Xu 5996; **Shandong**, Island Lingshan, Z. T. Zhao 91258, Yantai city, Mt. Kunyushan, J. B. Chen, 22157, 22167; **Beijing**, Mt. Jinshan, J. C. Wei & X. Y. Wang, 0025; **Taiwan**, Taizhong city, Asahina F-103 (TNS).

Discussion. This species is similar to *P. sorediata* in morphology and chemistry. It has been reported under the name of *Pyxine sorediata* in China (Wei 1991). However, *P. endochrysina* has the lobes with nodular isidia which sometimes break and expose the yellow medulla, while *P. sorediata* has the lobes with capitate soralia which are white, yellow and blue-black on margins.

7. Pyxine limbulata Müll. Arg., Flora **71**: 112 (1891)

=*Pyxine meissneri* var. *vulnerata* Hue, Nouv. Arch. Mus. Hist. Nat., Ser. **4**, **2**: 83 (1900); *Pyxine vulnerata* (Hue) Asahina, Bull. Nat. Sci. Mus. Tokyo **45**: 384 (1959).

=*Pyxine subolivacea* Zahlbr. in Handel-Mazzetti, Symb. Sin. **3**: 235 (1930).

Thallus foliose, yellowish brown, loosely attached on bark, orbicular or suborbicular, up to 6.5cm in diameter; lobes 0.5-2.5mm wide, flat or concave, tips mostly upturned, imbricate or discrete, white pruina present, especially near the end of lobes; white pseudocyphellae on margins, linear; devoid of soredia, isidia and lobules. Medulla yellow. Underside dark brown to black, rhizines dense, simple and black. Apothecia black, up to 2.0mm in diameter, margin entire with thalloid exciple containing algae when young, disappearing when old. Internal stipe pale brown, K+ pale red. Ascospores mostly *Physcia* type, *Pachysporaria* also present, 18.3-23.2×7.3-8.5μm.

Chemistry: cortex UV-, K+ yellow; medulla K-, C-, PD-. TLC: ±atranorin, terpenes.

Distribution. So far, *Pyxine limbulata* has been only reported in China and Japan, and is thought to be endemic to eastern Asia (Kashiwadani 1977). In China, this species has been known in South China (Wei 1991), now the range also includes Northeast China.

Representative specimens examined: **Yunnan**, Mt. Yulong, X. Y. Wang *et al.* 5701, 5715, Lijiang county, Y. M. Jiang 231-5, Zhongdian county, X. Y. Wang *et al.* 5284, Weixi county, J. J. Su 0240; **Xizhang**, Chayu county, J. J. Su 4221; **Jilin**, Jiaohe county, Y. M. Jiang & J. B. Chen 1443, Ji'an X. L. Chen 2441-1 (IFP); **Heilongjiang**, Muling county, J.C. Wei 2599-5, Wuminghe X. L. Chen 5339 (IFP); **Zhejiang**, Mt. Tianmu shan, J. D. Zhao & L. W. Xu 6225; **Taiwan**, Nantou Satoshi Nakanishi 12931a (TNS), Taizhong, Syo Kurokawa 2521 (TNS).

Discussion. *Pyxine limbulata* is distinguished from the similar *P. rhodesiaca* by the pale brown internal stipe (K+ red).

8. Pyxine meissnerina Nyl., Bull. Soc. Linn. Normandie, Ser. 2, 7: 164 (1873).

Thallus foliose, yellowish brown, closely adnate to bark; lobes up to 1.5mm in wide, dichotomously branched, apices round, white pruina present on the upper surface in patches, covering large areas; pseudocyphellae indistinct, mostly located on margins; soralia initiated from the cracked thallus, marginal to laminal; soredia white to yellow, granular. Medulla yellow. Underside dark brown to black; rhizines sparse, black simple. Apothecia not seen from Chinese materials.

Chemistry: cortex UV-, K+ yellow; medulla K-, C-, PD-. TLC: atranorin, tritepenes and an unknown substance.

Distribution. *Pyxine meissnerina* has been reported in east Africa (Swinscow & Krog 1975), Japan (Kashiwadani 1977c) and India (Awasthi 1982). Now the range extends to China.

Specimens examined: **Yunnan**, Xishuangbanna, J. B. Chen 6551.

Discussion. *P. meissnerina* is similar to *P. sorediata*. However, they have different chemical contents. Moreover, the former has paler soredia and indistinct pseudocyphellae which are strong developed in *P. sorediata*. Pruina in *P. meissnerina* are in large laminal patches, whereas in *P. sorediata* they are absent or present in small punctiform patches near the end of the lobes.

9. Pyxine philippina Vain., Philipp. J. Sci. **8**: 110 (1913).

Thallus foliose, pale brown, adnate to bark, orbicular or suborbicular, up to 6.0 cm in diameter; lobes 0.5-1.2mm wide, linear, radiate, discrete; pruina absent, pseudocyphellae white, lamianal, irregular; soralia, isidia and lobules all absent. Medulla white to pale yellow. Underside black; rhizines sparse, black and simple. Apothecia black, 1.5cm in width; margin with thalloid exciple when young, but becoming black due to loss of algae and carbonization when old. Ascospores brown, with two cells, *Pachysporaria* and *Physcia* type also present, the former dominant, 18-23.2(-24.4)×(6.1-)7.3-8.5(-9.8)μm.

Chemistry: cortex UV-, K+ yellow; medulla K+ yellow→red, C-, PD+ red. TLC: atranorin, norstictic acid terpenes and testacein.

Distribution. *Pyxine philippina* has been reported in Japan (Kashiwadani 1977c), Papua New Guinea (Kashiwadani 1977a) and India (Awasthi 1982). In China, this species has been known in Taiwan (Wei 1991), now its distribution extends to mainland China.

Specimens examined: **Yunnan**, Xishuangbanna, J. B. Chen 6525, Yingjiang county, X. Y. Wang *et al.* 2952; **Taiwan**, Taizhong S. Kurokawa, 2638 (TNS), Taibei Y. Asahina F-98b (TNS).

Discussion. The spores of all species in the genus *Pyxine* were previously described as *Physcia*-type. However, in the specimens 2638 and 6525, *Pachysporaria*-type spores are dominant although *Physcia*-type spores are present. Spores of intermediate type are also observed. This species is easily distinguished from other *Pyxine* species in China by the lack of vegetative propagules and the presence of norstictic acid in the medulla.

10. Pyxine sorediata (Ach.) Mont. in Sagra, Hist. Cuba. **9**: 188 (1842)
≡*Lecidea sorediata* Ach., Syn. Meth. Lich. 54 (1814).

Thallus foliose, yellow-gray, loosely attached on bark and rocks, orbicular or suborbicular, up to 14.0cm in diameter; lobes up to 2.0mm wide, mostly dichotomously branched, flat or concave, round at the apices; white pruina on the upper surface; linear pseudocyphellae present on the margins, white; soralia mostly marginal or terminal, capitate, white to blue-black, soredia granular. Medulla yellow. Underside black; rhizines dense, black or pale brown, simple or bifurcate at the end, 1-2mm long. Apothecia not seen from Chinese materials.

Chemistry: cortex UV-, K+ yellow; medulla K-, C-, KC-, PD-. TLC: ±atranorin, zeorin and terpenes.

Distribution. *Pyxine sorediata* is distributed mainly in the tropical and subtropical regions (Imshaug 1957, Swinsow & Krog 1975, Awasthi 1982, Kashiwadani 1977b, Rogers 1986). In China, this species has a wide distribution from tropic to temperate zones.

Representative specimens examined: **Yunnan**, Lijiang county, Y. M. Jiang 413-2, J. D. Zhao & L. W. Xu 4602, Baoshan county, 800, Hushui county, X. Y. Wang *et al.* 2146, Xishuangbanna J. B. Chen 6510-1, Y. M. Jiang 1162, Weixi county, X. Y. Wang 3876, Mangshi county, Y. M. Jiang 567, Simao county, Baliangsiji 1031; **Anhui**, Mt. Huangshan, J. D. Zhao & L. W. Xu 5995; **Guangxi**, Longsheng county, J. D. Zhao & L. W. Xu 8932, J. B. Chen *et al.* 20009; **Hunan**, Mount. Hengshan, J. D. Zhao & L. W. Xu 9846; **Sichuan**, Mt. E'mei, J. D. Zhao & L. W. Xu 6756; **Heilongjiang**, Ningan county, C. F. Zhao 965 (IFP), Muling county, J. C. Wei 2599-4, Dailing, J. B. Chen & G. R. Hu 21936, Mt. Xiaoxing'anling, X. L. Chen 5270-1 (IFP), Wudalianchi county, J. B. Chen & G. R. Hu 21909, Huzhong county, J. B. Chen & G. R. Hu 21794; **Jilin**, Dunhua city, C. F. Zhao & D. E. Gao 4057 (IFP), Mount. Changbai, J. C. Wei 2826, X. D. Lu 0042, Antu county, C. F. Zhao & D. E. Gao 3304 (IFP), X. L. Chen 5117 (IFP), Jiaohe county, J. B. Chen & Y. M. Jiang A-1203-1, Linjiang county, X. D. Lu 0745; **Fujian**, Mt. Wuyishan, S. L. Wang 14676.

11. Pyxine subcinerea Stirt., Trans. Proc. New Zealand Inst. **30**: 397 (1897).

Thallus foliose, yellowish brown to dark brown, closely appressed to bark, irregular; lobes less than 1.0mm wide, irregularly or dichotomously branched, flat or concave, apices round; white pruina in patches on the upper surface; pseudocyphellae absent or pale on margins; soralia marginal, soredia white to yellow. Medulla yellow. Underside brown; rhizines sparse, simple and brown. Apothecia not seen from Chinese materials.

Chemistry: cortex UV+ yellow, K-; medulla K-, C-, KC-, PD-. TLC: lichexanthone and terpenes.

Distribution. *Pyxine subcinerea* has been reported in Papua New Guinea (Kashiwadani 1977c), Australia (Rogers 1986), Europe (Moberg 1983) and Brazil (Kalb 1987). In China, *P. subcinerea* was only known in Taiwan before, but it is now recorded on mainland China.

Specimens examined: **Zhejiang**, Mt. Tianmu J. D. Zhao & L. W. Xu 6039-1, **Guangxi**, Shangsi county, J. B. Chen *et al.* 20473, **Hainan**, Xishaqundao, F. W. Xing 1-1, **Taiwan**, Nantou county, Asahina 3677 (TNS).

Discussion. This species is characterized by the UV+ thallus due to its containing lichexanthone and the marginal soralia.

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THE GENERA CYSTODERMA AND CYSTODERMELLA (TRICHOLOMATACEAE) IN TEMPERATE EURASIA

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Abstract: This paper presents a key and descriptions for 15 species of *Cystoderma* and *Cystodermella*. Representative material from Northern, Middle and Eastern Europe and from Asia-Temperate regions of the former Soviet Union was examined and evaluated. Data on the general distribution and remarks on specific features are provided for each species.

Key words: Agaricales, distribution, ecology

Introduction

The agaric genus *Cystoderma*, established by Fayod (1889), includes several species from the tribe *Lepiota* of the genus *Agaricus* Fries (1821). Fayod assigned *Lepiota amianthina*, *L. granulosa*, *L. cinnabarina*, *L. carcharias*, *L. seminuda* and *L. fumosopurpurea* to this new genus and suggested *L. georginae* as a possible member. The first four species have remained in this genus. However, species with free gills viz. *L. seminuda* and *L. georginae* are considered members of the genus *Lepiota*. Finally, *L. fumosopurpurea* has been excluded, because it has been deemed synonym to *Melanophyllum echinatum* (Roth.: Fr.) Singer. Konrad & Maublanc (1924-37) classified *Cystoderma* as a genus in the Tricholomataceae. Kühner & Maire (1934) recognised the genus, but Kühner (1936) subsequently included *Cystoderma* in the genus *Lepiota*.

The first monograph of the genus *Cystoderma* (Smith & Singer, 1945) includes 14 species from North America and, based on the Melzer reaction of spore walls, assigns the taxa into two sections: *Granulosa* (inamyloid basidiospores) and *Amianthina* (amyloid basidiospores). Heinemann & Thoen (1973) recognise 26 species and allocate the taxa into four sections, including sections *Superba* (basidiospores amyloid only at suprahilar zone) and *Cinnabarina* (inamyloid basidiospores, cheilocystidia present). Harmaja (2002) evaluated the taxonomic weight of the spore variation within *Cystoderma* mentioned above and considered the results of a study on the nuclear DNA content of selected species (Saar & Kullman, 2000). Likewise he took into account the results of the phylogenetic analysis by Moncalvo et al. (2002) and divided *Cystoderma* into two genera: *Cystoderma* s. str. contains species that possess amyloid basidiospores and *Cystodermella*, a new genus, encompassing species with inamyloid basidiospores. Three species of both genera (*Cystoderma amianthinum*, *C. carcharias*, *C. jasonis* and *Cystodermella adnatifolia*, *C. cinnabarina*, *C. granulosa*) feature binuclear basidiospores, but different nuclear DNA content (Saar & Kullman, 2000).

Controversy remains with respect to the taxonomic classification of *Cystoderma* s. l.

Singer (1986) appoints the genus in the family Agaricaceae and proposes the tribe Cystodermateae (1951). However, Thoen (1967), Heinemann & Thoen (1973), Kühner (1980), Bas (1988) and Kirk et al. (2001) regard *Cystoderma* as a member of the family Tricholomataceae.

My interpretation — that *Cystoderma* s. l. is a genus of the Tricholomataceae — is based on the following distinctive characters: white to pale cream spore-print, hyaline basidiospores, adnate lamellae (usually free in the family Agaricaceae), stipe and pileus tissues confluent and not readily separable, hyphae with clamp connections, and homomorphic lamellar edges (except in *C. cinnabarina*).

Kühner (1980) noted that the structure of the spore wall in species of *Cystoderma* s. l. is simple, consisting only of an episporium covered by a thin non-differentiated myxosporium.

Although the large nuclear subunit rDNA sequences suggest that the tribe Cystodermateae represents a distinctive taxon (Johnson & Vilgalys, 1998; Moncalvo et al., 2000), its taxonomic placement, either in Agaricaceae or Tricholomataceae, still remains unresolved (Moncalvo et al., 2000, 2002).

Of the thirty species of *Cystoderma* s. l. known world-wide (Kirk et al., 2001), fifteen taxa have been reported in Fennoscandia (Hansen & Knudsen, 1992).

Materials and methods

Fifteen species of *Cystoderma* s. l. (totalling 751 specimens) were examined in this study. The specimens were on loan from the herbaria H, O, REG or represent collections kept in TAA.

The material was mounted in 3 % potassium hydroxide (KOH) and Melzer's reagent and examined using 600x and 1000x magnification (Swift M4000-D). Ten basidiospores were measured for each specimen. The quotient of spore length to spore width (Q) was calculated as Q_{min} - Q_{max}, where Q_{min} and Q_{max} denote the minimum and maximum values of the quotient.

The number of nuclei in basidiospores was counted under 1000x magnification using the fluorescence microscope (Olympus Vanox). The nuclei were dyed with propidium iodide (Saar & Kullman, 2000).

General distribution data were based both on the examined specimens and literature records (Arnolds, 1984; Azbukina et al., 1984; Begljanova, 1972; Courtecuisse & Duhem, 1995; Hansen & Knudsen, 1992; Huhtinen, 1987; Kalamees & Botashev, 2000; Karatygin et al., 1999; Kovalenko & Morozova, 1999; Melik-Chatchatrian et al., 1985; Miller, 1993; Minter et al., 2001; Perevedenceva, 1997; Petrenko, 1978; Samgina, 1985; Serzhanina, 1994; Shubin & Krutov, 1979; Sivertsen et al., 1994; Urbonas, 1999; Urbonas et al., 1986; Vasileva, 1973; Vasileva & Nazarova, 1972; Vishnevsky, 1998; Wasser, 1980, 1985, 1993; Watling & Thurnbull, 1998).

World geographical regions have been designated using Brummitt (2001). Locations in Fennoscandia incorporate abbreviations for biogeographic provinces in this area (Hansen & Knudsen, 1992).

The abbreviations for world geographical regions (Brummitt, 2001) are as follows. **Europe:** Northern Europe: Denmark - DEN, Finland - FIN, Great Britain - GBR, Iceland - ICE, Ireland - IRE, Norway - NOR, Svalbard - SVA, Sweden - SWE; Middle Europe: Austria - AUT, Belgium - BGM, Germany - GER, Hungary - HUN, Netherlands - NET, Poland - POL, Switzerland - SWI; Southwestern Europe: France - FRA, Portugal - POR, Spain - SPA; Southeastern Europe: Greece - GRC, Italy - ITA, Romania - ROM; Eastern Europe: Belarus - BLR, Estonia - EST, Latvia - LAT, Lithuania - LIT, Krym (Crimea) - KRY, Central European Russia - RUC, East European Russia - RUE, North European Russia - RUN, Northwest European Russia - RUW, Ukraine - UKR. **Asia-Temperate:** Caucasus: North Caucasus - NCS, Transcaucasus - TCS; Middle Asia: Kazakhstan - KAZ, Kirgizstan - KGZ; Russian Far East: Amur - AMU, Kamchatka - KAM, Khabarovsk - KHA, Magadan - MAG, Primorye - PRM, Sakhalin - SAK; Siberia: Altay - ALT, Buryatiya - BRY, Irkutsk - IRK, Krasnoyarsk - KRA, Tuva - TVA, West Siberia - WSB, Yakutiya - YAK; Eastern Asia: Japan - JAP. **Northern America:** Subarctic America: Alaska - ASK, Greenland - GNL; Western Canada: British Columbia - BRC; Eastern Canada: Québec - QUE. **Southern America:** Caribbean: Dominican Republic - DOM; Northern South America: Venezuela - VEN. **Africa:** Northern Africa: Algeria - ALG, Morocco - MOR.

Spore measurements

Differences in mean spore length and width, as well as in the spore length to width ratio, were determined among closely-related species of the genus *Cystoderma* s. l. (Table 1).

Table 1. Means of spore length (L), width (W) and quotient (Q) for the species of the genus *Cystoderma* s. l. Standard deviation denoted by (d).

Species	L ± d	W ± d	Q ± d	Specimens examined (N)
C. ambrosii	4.42 ± 0.27	2.56 ± 0.11	1.73 ± 0.14	9
C. adnatifolium	4.23 ± 0.18	2.50 ± 0.14	1.69 ± 0.09	58
C. granulosum	4.09 ± 0.12	2.26 ± 0.19	1.82 ± 0.13	65
C. cinnabarinum	4.02 ± 0.10	2.24 ± 0.17	1.80 ± 0.13	69
C. carcharias	4.39 ± 0.30	3.07 ± 0.11	1.43 ± 0.08	119
C. fallax	4.44 ± 0.24	3.05 ± 0.12	1.46 ± 0.08	34
C. amianthinum	5.45 ± 0.37	3.04 ± 0.10	1.79 ± 0.11	211
C. intermedium	5.63 ± 0.67	3.03 ± 0.09	1.86 ± 0.18	4
C. jasonis	6.40 ± 0.29	3.16 ± 0.14	2.03 ± 0.10	99
C. lilacipes	6.41 ± 0.28	3.35 ± 0.15	1.92 ± 0.09	39
C. saarenoksae	6.33 ± 0.34	3.38 ± 0.17	1.88 ± 0.09	34
C. niveum	6.77 ± 0.56	3.33 ± 0.28	2.03 ± 0.08	3
C. superbum	4.64	3.26	1.42	1
C. arcticum	6.16 ± 0.28	4.10 ± 0.09	1.50 ± 0.04	4
C. tuomikoskii	5.60	3.80	1.47	1

The species were divided into statistically distinct groups by means of Anova (Tukey HSD for Unequal N) based on each measurement parameter. The mean spore length resulted in four groups viz. 1) *C. cinnabarinum*, *C. granulosum*; 2) *C. adnatifolium*, *C. carcharias*, *C. fallax*; 3) *C. amianthinum*, *C. intermedium*; 4) *C. jasonis*, *C. lilacipes*, *C. saarenoksae*, *C. niveum*.

The mean spore width yielded five groups viz. 1) *C. cinnabarinum*, *C. granulosum*; 2) *C. adnatifolium*, *C. ambrosii*; 3) *C. amianthinum*, *C. carcharias*, *C. fallax*; 4) *C. jasonis*; 5) *C. lilacipes*, *C. saarenoksae*. Finally, four groups were determined with respect to Q, viz. 1) *C. carcharias*, *C. fallax*; 2) *C. adnatifolium*; 3) *C. amianthinum*, *C. cinnabarinum*, *C. granulosum*, *C. lilacipes*, *C. saarenoksae;* 4) *C. jasonis*.

The following species — *C. ambrosii*, *C. arcticum*, *C. intermedium*, *C. niveum*, *C. superbum* and *C. tuomikoskii* — were represented by too few specimens to be allotted into groups with statistical significance.

Species with amyloid basidiospores (*C. amianthinum*, *C. carcharias*, *C. fallax*, *C. jasonis*, *C. lilacipes*, *C. saarenoksae*) feature longer and wider basidiospores than species with inamyloid basidiospores (*C. adnatifolium*, *C. granulosum*, *C. cinnabarinum*) except for *C. adnatifolium*, whose spore length suggests association in a group with species *C. carcharias* and *C. fallax*.

Comparison of spore length reveals no statistical significant difference between the closely related species *C. jasonis*, *C. lilacipes* and *C. saarenoksae*. Nor is there any difference in spore width of the species *C. lilacipes* and *C. saarenoksae*. However, the basidiospores of both species are significantly wider than those of *C. jasonis*. *C. amianthinum* is distinguished from closely related *C. jasonis* by smaller basidiospores. Spore size reveals no significant difference between the sister species *C. carcharias* and *C. fallax*.

Comparison of the spore lengths and widths of the closely related species *C. granulosum* and *C. cinnabarinum* reveals no significant difference whereas the spore length, width and quotient of the species *C. adnatifolium* are significantly different than those of the species *C. granulosum* and *C. cinnabarinum*. With respect to spore size, *C. granulosum* is more closely related to *C. cinnabarinum* than to *C. adnatifolium*.

Taxonomy

Cystoderma Fayod, Ann. Sci. Nat. Bot., sér. VII 9: 350. 1889.
Type species: *Agaricus amianthinus* Scop.: Fr., Hymenomyc. eur.: 37. 1874.

Basidiocarp small to medium. **Pileus** convex, plano-convex, then expanded, often umbonate, matt, dry, granulose, sometimes becoming smooth with age; the margin at least in young specimens denticulate from remnants of veil. **Pileipellis** formed by chains of globose to ellipsoid thin-walled cells – **sphaerocysts**. The walls of sphaerocysts smooth or with an incrusting pigment, hyaline or yellowish or cinnamon to rusty in KOH. **Lamellae** adnexed to adnate, often emarginate, sometimes with decurrent tooth, thin, crowded, with homomorphic edge, **trama** regular to subregular. **Lamellulae** present. **Stipe** central, stuffed; at apex glabrous, silky striate; with persistent membranous ring or evanescent floccose-scaly ring zone; below, mostly fragmentary, covered with flocks issued from the remnants of veil, identical in colour and structure to pileus surface. **Stipe trama** confluent with that of the pileus. **Context** of the pileus fleshy, hyphae hyaline, with clamp connections, inamyloid. **Arthrospores** formed by some species in the upper part of pileus context. **Odour** absent or slightly to distinctly unpleasant. **Basidiospores** broadly ellipsoid, ellipsoid to oblong, rarely fusiform, germ pore absent, wall homogeneous, smooth, thin, hyaline, amyloid, binuclear. **Spore-print** white to pale cream. **Basidia** clavate, 4-spored, hyaline. **Cheilocystidia** absent. **Habitat** coniferous and mixed forests or rarely grasslands, on decay, litter and moss, more rarely on rotten wood. Late summer to late autumn.

Cystodermella Harmaja, Karstenia 42: 43. 2002.
Type species: *Agaricus granulosus* Batsch: Fr., Syst. mycol. I: 24. 1821.
Differences from ***Cystoderma*** (for additional information see Harmaja (2002) - **Basidiospores** inamyloid. **Cheilocystidia** occur in few species.

Key to species referred to in this contribution

1	Stipe with persistent flaring membranous ring.	2
1*	Stipe with evanescent floccose-scaly ring zone.	6
2	Basidiospores 4-5 x 3-3.5 μm, amyloid, broadly ellipsoid to ellipsoid.	3
2*	Basidiospores longer (>5 μm) than above.	4
3	Pileus and stipe white with greyish pink or vinaceous tinge.	**3. *Cystoderma carcharias***
3*	Pileus rusty (rarely medium brown or ochre).	**4. *Cystoderma fallax***
4	Pileus ochre, ring narrow. Basidiospores 5-6 x 2.5-3.5 μm, oblong.	**5. *Cystoderma intermedium***
4*	Pileus brown, basidiospores wider (>3.5 μm) than above, broadly ellipsoid to ellipsoid.	5
5	Pileus fulvous brown. Basidiospores 5-7 x 3.5-4.5 μm.	**11. *Cystoderma tuomikoskii***
5*	Pileus rusty brown. Basidiospores 6-10 x 4-6 μm.	**2. *Cystoderma arcticum***
6	Basidiospores amyloid.	7
6*	Basidiospores inamyloid.	11
7	Basidiocarp white. Basidiospores 5.5-8.0 x 3.0-4.5 μm, oblong to fusiform.	**8. *Cystoderma niveum***
7*	Basidiocarp coloured.	8
8	Pileus yellowish ochre.	9
8*	Pileus brownish ochre to dark brown.	10
9	Lamellae white. Basidiospores 5-6.5 x 2.5-3.5 μm, ellipsoid to oblong. Arthrospores lacking or rare beneath pileipellis context.	**1. *Cystoderma amianthinum***
9*	Lamellae yellowish. Basidiospores 6-7.5 x 3-4 μm, oblong to fusiform. Arthrospores abundant.	**6. *Cystoderma jasonis***
10	Stipe apex violet or purple. Basidiospores 6-7.5 x 3.5-4 μm, oblong to fusiform.	**7. *Cystoderma lilacipes***
10*	Pileus brownish ochre. Basidiospores 5.5-7.5 x 2.5-4 μm, oblong to fusiform.	**9. *Cystoderma saarenoksae***
11	Basidiocarp white. Basidiospores 4-5.5 x 2.5-3 μm, ellipsoid to oblong.	**13. *Cystodermella ambrosii***
11*	Basidiocarp coloured	12
12	Pileus with different shade of brown. Basidiospores 3.5-4 x 2-2.5 μm, oblong.	**14. *Cystodermella granulosa***
12*	Pileus brownish orange or red	13
13	Cheilocystidia absent. Basidiospores 4-5 x 2-2.5 μm, ellipsoid to oblong.	**12. *Cystodermella adnatifolia***
13*	Cheilocystidia present. Basidiospores 3.5-4 x 2-2.5 μm, ellipsoid to oblong.	**15. *Cystodermella cinnabarina***

1. *Cystoderma amianthinum* (Scop.) Fayod, Ann. Sci. Nat. Bot., sér. VII 9: 351. 1889.
Syn.: *Agaricus amianthinus* Scop., Fl. carn. 2 (2): 434.1772.
Lepiota amiantina (Scop.) P. Karst., Ryssl. Hattsvamp.: 15. 1879.
C. rugosoreticulata (F. Lorinser) Wasser, Ukrayins'k. Bot. Zhurn. 35 (5): 516. 1978.

Pileus 15-50 mm, convex to plano-convex, buff, yellowish buff, cinnamon buff, saffron buff; usually with darker umbo; granulose, margin at first with remnants of veil; surface often radially wrinkled. **Lamellae** white, whitish or light cream when wet or old, adnate to adnexed, crowded. **Stipe** 25-60 x 2-7 mm; at apex whitish and silky striate; with evanescent floccose-scaly ring zone; below concolorous with or darker than pileus, covered with flocks, often glabrous with age. **Context** white to whitish, in stipe yellowish. **Odour** usually unpleasant. **Basidiospores** (4.0-) 5.0-6.0 (-7.0) x (2.5-) 3.0-3.5 (-4.0) µm, Q = 1.52-2.13, ellipsoid to oblong, amyloid. **Basidia** clavate, 4-spored, 18-27 x 4-6 µm. **Cheilocystidia** absent. **Sphaerocysts** darkening in KOH, cinnamon to rusty. **Arthrospores** in the upper part of pileus context below the sphaerocysts layer are lacking or thinly scattered.

Habitat coniferous and mixed forests or, rarely, grasslands, on soil among moss and litter, July-November, common.

General distribution. Europe: DEN, FIN, GBR, ICE, IRE, NOR, SWE; AUT, BGM, GER, HUN, NET, POL; FRA; GRC, ITA, ROM; BLR, EST, LAT, LIT, RUC, RUE, RUN, RUW, UKR. **Asia-Temperate:** ALT, BRY, IRK, KRA, WSB, YAK, KAM, KHA, PRM; KGZ; NCS, TCS; JAP. **Northern America:** ALT, GNL; QUE. **Southern America:** DOM; VEN. **Africa:** ALG, MOR.

Remarks. *C. amianthinum* is characterized by the yellowish buff coloured pileus, white lamellae and amyloid basidiospores. *C. jasonis* features a deeper basidiocarp colour and larger basidiospores. *C. saarenoksae* has yellowish buff lamellae and longer basidiospores. Sclerospores and sclerobasidia, with thickened dextrinoid and cyanophilic walls, mentioned by Harmaja (1979), were observed in some specimens. The erratic presence of these structures makes them unsuitable as a specific diagnostic character.

Specimens examined. Europe. EST. Harju Co.: Nissi, 18.09.57, Kalamees (TAA 70665), Pirga, 15.11.59, Kalamees (TAA 71557), Käsmu, 22.08.89, Kytövuori 89-222 (H), Paimetsa, 25.09.95, Vaasma (TAA 142741), Järlepa, 27.09.95, Vaasma (TAA 142781), Paunküla, 28.09.95, Vaasma (TAA 142786), Naissaar, 04-06.10.01, Saar (TAA 182048, 182049, 182054,182061, 182064); Hiiu Co.: Tahkuna, 13.09.01, Saar (TAA 182033, 182034), Lauka, 13.09.01, Saar (TAA 182035), Mäepe, 15.09.01, Saar (TAA 182038), Mäeselja, 16.09.01, Saar (TAA 182044), Sääre tirp, 17.09.01, Saar (TAA 182046), Jõesuu, 17.09.01, Saar (TAA 182047), Puski, 14.09.01, Kollom (TAA 128267); Jõgeva Co.: Aru, 24.09.60, Kalamees (TAA 71857), Rünga, 25.09.65, Kalamees (TAA 52248), Vooremaa, 70, Kalamees, Kollom (TAA 82455), Võiviku, 27.09.97, Vaasma (TAA 171618), Kaarepere, 09.12.00, Saar (TAA 182021); Järva Co.: Huuksi, 22.09.95, Vaasma (TAA 142717, 142718), Aela-Virla, 23.09.95, Vaasma (TAA 142733); Lääne Co.: Vormsi, 20.09.86, Kalamees (TAA 143437), Dirhami, 06.10.93, Kalamees (TAA 146114); Lääne-Viru Co.: Tudu-Järvesoo, 96, Ploompuu (TAA 147241), Neeruti, 23-24.09.00, Saar (TAA 182010, 182012); Põlva Co.: Laessaare, 25.09.55, Kalamees (TAA 70133), Taevaskoja, 16.10.55, 08.09.56, 20.10.93, 07.10.95, 02.11.96, Kalamees (TAA 70204, 70344, 146163, 146707, 147566, 147567, 147568), Kiidjärve, 15.10.95, Saar (TAA 147303), Mooste, 06.09.98, Kullman (TAA 157979); Pärnu Co.: Salupeaksi, 19.09.98, Kalamees (TAA 147989); Saare Co.: Kihelkonna, 07.09.79 (TAA 113400), Kaali, 07.10.83 (TAA 141097), Kessulaid, 10.10.83, Kalamees (TAA 123304), Harilaid, 12.09.93, Kytövuori 93-1062 (H), Selgase, 16.09.93, 05.10.96, Kalamees; Saar, Gahne (TAA 146052; 147308, 146947), Audaku, 03.10.96, Liiv, Lumiste, Saar (TAA 147304, 147305); Tartu Co.: Variku, 09.10.46, Witkovski (TAA 114426, 142331), Rannaküla, 04.10.61, Kalamees (TAA 72655), Ahunapalu, 07.10.89, 29.10.95, 08.09.99, Kalamees (TAA 144411, 146736, 146737, 175248), Kabina, 14.10.95, Saar (TAA 147300), Terikeste, 16-25.08.96, Kalamees (TAA 147953, 147967), Tõllassaare, 10.10.96, Vaasma (TAA 142905), Sellisaare, 17.10.96, Leenurm, Saar (TAA 147325, 147326), Selgase, 23.07.97, Kalamees (TAA 147983), Trepimäe, 13.09.98, Kullman (TAA 147397), Järvselja, 05.09.99, Rantala, Tedersoo, Saar (TAA 147398, 147399), Agali, 07.09.99, Hanso, Saar (TAA 147400, 147401), Kaagvere, 10-16.10.99, 15.10.00, Saar (TAA 147420, 147421, 147426, 147427, 147429, 147432, 147433, 147434, 147435, 147437, 147438, 147440, 147443; 147455, 147459, 147460, 147461, 147462, 147463, 182016, 182017), Metsanurga, 16.10.99, Saar (TAA 147446, 147447), Vooremägi, 17.10.99, 30.11.99, Saar; Kalamees (TAA 147467, 147470, 147471, 147472, 147473, 147474, 147475, 147477, 147480; 147481), Kurepalu, 21.09.00, Kalamees (TAA 175655), Keeri, 08.12.00, Tedersoo (TAA 182020); Valga Co.: Hargla, 17-18.10.96, Kalamees (TAA 147293, 147297, 147515, 147517, 147518), Aakre, 04-09.08.98, Leenurm; Kullman (TAA 147386, 147388); Võru Co.: Vungi, 27.09.57, Kalamees (TAA 70719), Saruküla, 29.09.80, Paas (TAA 142330), Matsimäe, 12.08.81, Paas (TAA 182022), Kuklase, 11.10.96, Saar (TAA 147311), Luutsniku, 11.10.96, Saar (TAA 147314, 147316, 147317), Hino, 12.10.96, Saar (TAA 147320, 147321, 147322), Meeksi, 30.09.97, Saar, Kalamees (TAA 147342, 147844, 147847, 147848), Kütiorg, 03.10.97, Kollom, Liiv, Saar, Vaasma, Kalamees (TAA 147347, 147348, 147350, 147351, 171760), Rõuge, 27.09.97, Kalamees (TAA 171746). **LAT.** Jurmala, Kaugusri, 16.10.93, Kalamees, Vimba, Avota (TAA 146127); Kemeri National Park, 24.09.96, Kalamees (TAA 147005, 147007, 147010); Renceni, 07.10.97, Kalamees (TAA 147880); Saule, 08.10.97, Kalamees (TAA 147884, 147886); Maczalaca, 09.10.97, Kalamees (TAA 147896); Puiku, 10.10.97, Kalamees (TAA 147897); Rozeni, 10.10.97, Kalamees (TAA 147898). **FIN.** EH: Tampere, 10.97, Rantala (TAA 147358), Kuhmalahti, 27.10.97, Rantala (TAA 147364), Luopioinen, 28.10.97, Rantala (TAA 147365), Kangasala, 10.10.97, Rantala (TAA 147371, 147372), Tampere, 01.11.97, 22.08.98, Rantala, Saar (TAA 147376, 147377, 147389), Leenansaari, 15.09.99, Saar (TAA 147406, 147407), Ruovesi, 17.09.99, Saar (TAA 147412); Ks: Liikasenvaara, 10.09.81, Kalamees, Ohenoja, Ulvinen (TAA 122106). **NOR.** STr: Trondheim-Heimdal, 08.08.95, Kalamees, Liiv (TAA 146531, 146543); Troms: Mettevoll, 12.08.95, Kalamees, Liiv (TAA 146546); S&F: Solvorn, 09.09.00, Höijer, Saar (TAA 147493), Suphelledalen in Fjærland, 10.09.00, Saar (TAA 147495, 147497, 147499), Skadhaug above Hermansverk, 11.09.00, Saar (TAA 182001, 182003). **SWE.** Mpd: Borgsjö, 13.09.95, Kalamees (TAA 146656); Nb: Öden, 28.08.98, Saar (TAA 147395); Hls: Hudiksvall, 28.08.98, Saar (TAA 147396); Gtl: Kambs Gård, 04.10.98, Kalamees (TAA 147950), Halla, 04.10.98, Vaasma (TAA 172016, 172019), Åminne, 05.10.98, Vaasma (172029), Russvätar, 06.10.98, Vaasma (172041). **AUT.** Tirol, Leutasch, 29.09.80, Besl, Bergmann 104 (REG). **GER.** Kaltenbrunn b. Garmisch, 14.09.73, Bresinsky (REG); Oberbayern, Landsberg, 15.09.73, Bresinsky (REG); Etterzhausen, 28.09.76, 07.10.78, Besl 124, 69/78 (REG); Werdenfelser Land, Kochelbergwiesen, 21.09.79, Bresinsky (REG); Bruckdorf, 22.08.84, Meixner (REG); NP. Bayerischer Wald: Höhenbrunn, 21.09.85, Bresinsky (REG), Reschbachtal, 2006/1408, 06.10.85, Bresinsky (REG); Fichtelgebirge: Ochsenkopf b. Bischofsgrün, MTB: 5936/2, 10.10.85, Paulus 592 (REG), Eisenberg b. Oberwarmensteinach, MTB: 5936/4, 14-16.10.85, Paulus 399, 480, Bresinsky (REG); NP. Bayerischer Wald: Klosterfilz, 07.11.86, Luschka 61 (REG), Hirchlinger Stand, 20.09.87, Luschka 151 (REG); Ebenwies, 30.09.87, Besl (REG); Bruckdorf, 22.09.88, Kolb, Reisinger R452/88, Besl (REG); Hohengebraching, 7038/I, 07.09.89, Steidl, Reisinger R283/89 (REG); Teufelswinkel, MTB: 7037/1, 28.09.89, Aicher R540/89 (REG); Girnitztal, MTB: 6837, 05.10.89, Reisinger R612/89, Steidl (REG); Oberpfalz Gscheibte Loh, MTB: 6338/1, 28.10.89, Bresinsky (REG); Burghausen, MTB: 7742/4, 15.10.90, Reisinger R385/90 (REG); Eigelwald, MTB: 7841, 16.10.90, Reisinger R399/90 (REG); Steinerbrünnel, MTB: 6939/1, 22.10.90, Reisinger R489/90 (REG); Klosterforst nö. Kitzingen, MTB: 6227/3, 25.09.95, Krieglsteiner 1903 (REG); Hohengebrachinger Forst, 25.09.95, Besl (REG); Offenstetten, MTB: 7137/3, 22.09.97, Pilzkurs (REG); Sandgrube im Klosterforst, MTB: 6227/1, 12.10.97, Krieglsteiner 5065 (REG). **Asia-Temperate. KRA.** Jemeljanovsk, Krutaja, 30.08.83, Kalamees, Vaasma (TAA 123064); Chakassia, Znamenka, 02.09.87, Kalamees (TAA 143600, 143601). **KAM.** Atlasovo, 01.08.78, Kalamees, Kullman, Vaasma (TAA 84898); Kronoki Nature Reserve, 26.08.78, Kalamees, Vaasma (TAA 120272); 20 km N from Jelizovo, 27.08.78, Kalamees, Kullman, Vaasma (TAA 113110). **KHA.** Arsenjevo, 20.09.79, Kalamees, Vaasma (TAA 121035). **KGZ.** Terskey-Alatau Range, Karabatnau, 05.08.71, Kalamees, Kollom (TAA 79744). **NCS.** Karacheyevo-Cherkessiya, Teberda State Biosphere Reserve, Baduk, 27.08.99, Kalamees (TAA 175181). **Northern America. QUE.** L'Islet Co., St. Aubert, 01.10.63, Groves 93129 (TAA).

2. *Cystoderma arcticum* Harmaja, Karstenia 24: 31. 1984.

Pileus 10-50 mm, convex, plano-convex, yellow brown to rusty brown, often with umbo, finely granulose, margin at first with remnants of veil; often radially wrinkled. **Lamellae** buff, without pink tinge, adnate or adnexed, crowded. **Stipe** 18-70 x 5-11 mm, at apex silky striate; with well-developed persistent membranous ring; below concolorous with pileus, covered with flocks. The basis often enlarged downwards. **Context** whitish. **Basidiospores** (5.0-) 6.0-7.0 x 4.0-4.5 µm, Q = 1.46-1.54, broadly ellipsoid to ellipsoid, amyloid. **Basidia** clavate, 4-spored, 23-25 x 5-7 µm. **Sphaerocysts** darkening in KOH, cinnamon to rusty.

Habitat caespitose, in middle arctic zone tundra, on soil, often on moss, July-August, rare.

General distribution. Europe: NOR, SVA. **Asia-Temperate:** KRA, YAK. **Northern America:** ASK.

Remarks. *C. arcticum* is characterized by comparatively very large amyloid basidiospores and the well-developed and persistent membranous rings. The distribution of this species is limited to the arctic tundra. Although Harmaja (1984) reports on conspicuous thick-walled weakly dextrinoid sclerospores and sclerobasidia, no such features were observed in the examined specimens.

Specimens examined. Europe. NOR. STr: Oppdal, N. Knutshø, 1500 m, 24.08.85, Sivertsen (O 153775). **SVA.** Sassenfjorden, Gjelrabbane, 17.07.81, Gulden 102/81 (O 153776); Adventdalen, 28.07.81, Gulden 298/81, 298b/81 (O 153777, 153778); Vest-Spitsbergen, Longyearbyen, 17.08.88, Huhtinen 88/56 (H).

3. ***Cystoderma carcharias*** (Pers.) Fayod, Ann. Sci. Nat. Bot., sér. VII 9: 351. 1889.
Syn.: *Agaricus carcharias* Pers., Syn. meth. Fung.: 263. 1801.
Lepiota carcharias (Pers.) P. Karst., Ryssl. Hattsvamp.: 14. 1879.

Pileus 30-60 mm, convex to plano-convex, white with greyish pink or vinaceous buff tinge, rarely clay buff, often with darker umbo and radially wrinkled; granulose, margin at first with remnants of veil. **Lamellae** white to whitish, adnate to adnexed, crowded. **Stipe** 30-70 x 4-8 mm, at apex whitish and silky striate; with well developed persistent membranous flaring ring, granulose and concolorous with pileus on outer surface; below covered with flocks and granules, concolorous with pileus. **Context** white to whitish. **Odour** slightly to distinctly unpleasant. **Basidiospores** (3.5-) 4.0-5.0 (-6.0) x (2.5-) 3.0-4.0 µm, Q = 1.31-1.61, broadly ellipsoid to ellipsoid, amyloid. **Basidia** clavate, 4-spored, 20-25 x 4-6 µm. **Cheilocystidia** absent. **Sphaerocysts** colourless in KOH.

Habitat coniferous and mixed forests, on moss and decaying litter, August-December, common.

General distribution. Europe: DEN, FIN, GBR, IRE, NOR, SWE; AUT, BGM, GER, HUN, NET, POL, SWI; FRA, POR, SPA; GRC, ITA, ROM; BLR, EST, LAT, LIT, RUC, RUE, RUN, RUW, UKR. **Asia-Temperate:** ALT, KRA, WSB, YAK; PRM; NCS, TCS; JAP. **Northern N-America**.

Remarks. *C. carcharias* is well characterized by its pale pinkish or vinaceous coloured basidiocarp, its well-developed persistent membranous ring, amyloid basidiospores and colourless sphaerocysts in KOH. The closely related *C. fallax* has brown coloured pileus and cinnamon to rusty sphaerocysts.

Specimens examined. Europe. EST. Harju Co.: Nissi, 18.09.57, Kalamees (TAA 70664), Kongulaane, 14.11.59, Kalamees (TAA 71549), Paunküla, 28.09.95, Vaasma (TAA 142787), Leistu, 28.09.95, Vaasma (TAA 142798), Jüri, 03.10.95, Merisalu (TAA 142807), Viimsi, 05-06.12.96, Kalamees (TAA 147618, 147331), Naissaar, 04-05.10.01, Saar (TAA 182050, 182053); Hiiu Co., Mäepe, 15.09.01, Saar (TAA 182039); Jõgeva Co.: Mõisamaa, 27.09.60, Kalamees (TAA 71897), Lentsi, 27.12.60, Kalamees (TAA 72082), Vooremaa, 13.10.72, Kalamees, Kollom (TAA 114206, 114208); Järva Co.: Aela-Virla, 23.09.95, Vaasma (TAA 142730), Peetri, 05.12.96, Kalamees (TAA 147330), Ambla, 02.10.00, Kullman (TAA 159552); Lääne-Viru Co.: Viitna, 18.09.59, Kalamees (TAA 51292), Äntu, 24.09.65, Kalamees (TAA 52255), Viitna, 25.10.77, Pihlik (TAA 95672), Neeruti, 23.09.00, Liiv, Saar (TAA 182011); Põlva Co.: Taevaskoja, 06.11.55, 07.10.95, 02.11.96, Kalamees (TAA 70231, 146708, 146708A, 147566), Kiidjärve, 15.10.95, Saar (TAA 147302), Karisilla, 10.11.96, Saar (TAA 147329); Saare Co.: Audaku, 03.10.96, Saar (TAA 147306), Kihelkonna, 04.10.96, 14.08.98, Saar; Vaasma (TAA 147307; 171965), Selgase, 05.10.96, Kalamees, Saar (TAA 146948, 147185, 147309), Muhu, 06.10.96, Lundgvist (TAA 147310), Vilsandi, 08.12.00, Nilson (TAA 175723); Tartu Co.: Muri, 08.10.95, Kalamees, Vauras (TAA 146721, 146722), Kabina, 14.10.95, Saar

(TAA 147301), Ahunapalu, 29.10.95, Kalamees (TAA 146733, 146735), Lootvina, 26.10.96, Kullman (TAA 147327), Võiviku, 05.11.96, Järv (TAA 147328), Vorbuse, 11.12.96, Kalamees (TAA 147649), Mõisanurme, 11.12.96, Kalamees (TAA 147652), Variku, 20.10.97, Kullman (TAA 147353), Laeva, 23.10.97, Vaasma (TAA 171700), Kaagvere, 10-16.10.99, 15.10.00, Saar (TAA 147416, 147419, 147422, 147428, 147464, 147465, 147466, 147483, 182019), Konopi, 14.10.99, Saar (TAA 147444), Metsanurga, 16.10.99, Saar (TAA 147448, 147449, 147450), Vooremägi, 17.10.99, 30.11.99, Saar; Kalamees (TAA 147469, 147476, 147478, 147482); Võru Co.: Tõrvasoja, 16.08.80, Paas (TAA 142333), Saruküla, 29.09.80, Paas (TAA 142332), Luutsniku, 11.10.96, Saar (TAA 147312, 147313, 147315), Kokemäe, 12.10.96, Saar (TAA 147318), Hino, 12.10.96, Saar (TAA 147319), Järveküla, 12.10.96, Leenurm (TAA 147323), Vällamägi, 13.10.96, 02.10.97, Saar, Höijer (TAA 147345, 147324), Meeksi, 30.09.97, Saar, Kalamees (TAA 147334, 147845), Kütiorg, 03.10.97, Saar (TAA 147346, 147349); habitat unknown, 19.09.63, Kalamees (TAA 51638). **LAT.** Vitrupe, 10.10.97, Kalamees (TAA 147900). **RUN.** Murmansk, Heinasaar, 19.08.77, Kalamees, Pihlik, Vaasma (TAA 84136). **FIN.** EH: Pirkkala, 10.10.97, Linkoaho (TAA 147367), Tesoma, 10.10.97, Rantala (TAA 147368), Kangasala, 10.10.97, Rantala (TAA 147373); U: Askola, 13.10.97, Höijer (TAA 147384). **NOR.** S&F: Solvorn, 09.09.00, Höijer, Saar (TAA 147494), Suphelledalen in Fjærland, 10.09.00, Saar (TAA 147498), Skadhaug above Hermansverk, 11.09.00, Saar (TAA 182005, 182009). **SWE.** Gtl: Nyneshamn, 03.10.98, Vaasma (TAA 172011), Halla, 04.10.98, Vaasma (TAA 172024), Viklau, 04.10.98, Kalamees (TAA 147945, 147946), Kambs Gård, 04.10.98, Kalamees (TAA 147948), Tjaukle, 07.10.98, Vaasma (TAA 172049). **AUT.** Tirol, Kelchsau, 1200-1300 m, 25.08.73 (REG). **GER.** Oberbayern, Kaltenberg, 30.09.73, Bresinsky (REG); b. Regensburg, Mintrachinger Holz, 23/30.09.78, Bresinsky (REG); E. 12.10.78, Besl 74/78 (REG); Wülfersreuth, 11.09.84, Listl (REG); Etterzhausen, 08.10.84, Meixner (REG); Abzweigung Zwieseler Waldhaus, 23.10.84, Meixner (REG); NP. Bayerischer Wald: Feistenberg, 15.09.85, Bresinsky (REG), Rachelseewand, 26.08.86, Luschka 79 (REG), Lärchenberg, 13.08.87, Luschka 158 (REG); Fichtelgebirge: Fichterhast b. Bischofsgrün, MTB: 5936/2, 10.10.85, Paulus 578 (REG), Warmensteinach-Goldkronach, MTB: 5936/4, 08.10.86, Paulus 1289 (REG), Fichtelsee, MTB: 5937/3, 08.08.87, Paulus 1653 (REG), Thannenlohe b. Unterlind, MTB: 6037/1, 30.07.87, Paulus 1475 (REG); Binnendünengebiet St. Johann, 26.10.86, Bresinsky (REG); Sylt, Dünen b. List, 22.11.86, Bresinsky (REG); Girnitztal, 12.10.88, Reisinger R559/88 (REG); Wenzenbach, MTB: 6939/1, 27.09.89, Pilzkurs R512/89 (REG); Grasental, MTB: 6837/3, 10.10.89, Steidl, Reisinger R649/89 (REG); Siegenburg, MTB: 7236/2, 17.10.89, Steidl, Reisinger R728/89 (REG); Viehhausen g. Labertal, MTB: 7037/2, 09-10.94, Bresinsky (REG); Obere Fein b. Unterternach, MTB: 6124/2, 07.09.95, Krieglsteiner 2382 (REG); Oberh. Holle-Tal, MTB: 6024/1, 29.09.95, Krieglsteiner 2518 (REG).

4. *Cystoderma fallax* A. H. Sm. & Singer, Pap. Michigan Acad. Sci. 30: 116-118. 1945.

Pileus 20-50 mm, convex to plano-convex, rusty brown, rarely ochre, yellowish buff, cinnamon buff; often with umbo; granulose, margin at first with remnants of veil. **Lamellae** whitish or with pinkish tinge, adnate or adnexed, crowded. **Stipe** 30-80 x 3-8 mm, at apex with buff tinge and silky striate; with well-developed persistent membranous flaring ring, granulose and concolorous with pileus on outer surface; below concolorous with pileus, covered with flocks. **Context** whitish, below pileipellis pale brownish. **Odour** absent. **Basidiospores** (3.5-) 4.0-5.0 (-6.0) x (2.5-) 3.0-3.5 (-4.0) µm, Q = 1.26-1.66, broadly ellipsoid to ellipsoid, rarely oblong, amyloid. **Basidia** clavate, 4-spored, 18-25 x 4-5.5 µm. **Cheilocystidia** absent. **Sphaerocysts** darkening in KOH, cinnamon or rusty. **Arthrospores** are sometimes present and yellowish in KOH.

Habitat coniferous and mixed forests, on soil among moss and litter, August-October, rare.

General distribution. Europe: FIN, ICE, NOR, SWE; AUT, BGM, HUN; FRA; ITA; RUE, RUN. **Asia-Temperate:** BRY, KRA; NCS. **Northern America:** ASK. **Southern America:** DOM. **Africa:** MOR.

Remarks. *C. fallax* is characterized by brown coloured pileus, well-developed persistent membranous ring and broadly ellipsoid to ellipsoid amyloid basidiospores. *C. arcticum* and *C. tuomikoskii* feature longer and wider basidiospores. The occurrence of *C. arcticum* is restricted to arctic tundra.

Specimens examined. Europe. FIN. EH: Jahkola 05.09.70, Vänskä (H), Kilparisti, 07.09.70, Vänskä (H), Lampelto, 07.09.74, H. Salokoski (H), Hauhiala, 10.09.86, Helynranta, Einiö (H), Palonen, 03.09.81, Grönholm, Liedenpohja (H), Lammi, 04.10.84, Kalamees (TAA 124846); KiL: Mustavaara, 23.08.92, Kytövuori 92819, 92864 (H); Ks: Kuusamo, 21.08.74, Tuomikoski (H), Liikasenvaara, 24.08.78, Sjöblom, Albrecht (O 153823), Liikasenvaara, 04.09.81, Kytövuori 811133 (H), Korvasvaara, 10.09.81, Kalamees, Ohenoja, Ulvinen (TAA 122084, 122130), Vuotunki, 02.09.92, Kytövuori 92-1520 (H); PK: Juuka, 07.09.83, Kytövuori 83209 (H); PS: Lapinlahti, 23.8.56, Schulmann (H), Maaninka, 09.09.83, Kytövuori 83262 (H); SoL: Tulppio, 29.08.92, Kytövuori 92-1266, 92-1309 (H); U: Espoo, 23.09.66, Kalela, Tuomikoski (H), Tuusala, 05.09.67, Harmaja (H); V: Lohjansaari, 07.10.78, 06.10.79, Kytövuori 9662, 791040 (H), Karkkila, 22.09.79, Kytövuori 79886 (H), Kuusjoki, 28.09.80, Kytövuori 801225 (H). **NOR.** Finnm: Nesseby, 07.09.70, Ulvinen 265/70 (O 153822); Oppl: Lunner, 11.09.79, Bendiksen 371/79 (O 153821). **FRA.** Savoie, Lanslebourg-Mont Cenis, 30.08.92, Kalamees (TAA 145380). **Asia-Temperate. NCS.** Krasnodar, Guzeripl, 600 m, 02.09.75, Kalamees, Vaasma, Pihlik (TAA 94429); Sennaja, O-slope, 1200 m, 07.09.75, Kalamees, Vaasma, Pihlik (TAA 94523).

5. *Cystoderma intermedium* Harmaja, Karstenia 19: 27. 1979.

Pileus up to 25 mm, pale ochre to ochre, granulose, margin at first with remnants of veil. **Lamellae** whitish, adnate or slightly decurrent, crowded. **Stipe** 30-50 x 3-5 mm, at apex silky striate, same shade as pileus; with narrow persistent membranous ring; below concolorous with pileus, covered with flocks. **Context** whitish. **Basidiospores** 5.0-6.5 (-7.0) x (2.5-) 3.0-3.5 (-4) µm, Q = 1.69-2.03, oblong, amyloid. **Basidia** clavate, 4-spored, 20-22 x 4-5 µm. **Cheilocystidia** absent. **Sphaerocysts** darkening in KOH, yellowish.

Habitat spruce forests, on litter and moss, September-October, rare.

General distribution. Europe: FIN, NOR.

Remarks. Harmaja (1979) considers *C. intermedium* an intermediate between *C. amianthinum* and *C. fallax*. The brief original description does not allow the taxonomic evaluation of this species. The examined specimens indicate a close relationship to *C. amianthinum*.

Specimens examined Europe. FIN. EH: Janakkala, 08.10.77, Korhonen 2094, Tuomikoski (**holotype**, H); Ks: Liikasenvaara, 04.09.76, Korhonen, Tuomikoski (H); V: Pohja, Kuovila, 02.10.80, Kytövuori 801248 (H), Rymättylä, 10.10.82, Tuomikoski (H)..

6. *Cystoderma jasonis* (Cooke & Massee) Harmaja, Karstenia 18: 29, 1978.

Syn.: *Agaricus jasonis* Cooke & Massee in Cooke, Grevillea 16: 77. 1888.
Lepiota amianthina var. *longispora* Kühner, Bull. Trimestriel Soc. Mycol. France 52: 204. 1936.
C. amianthinum var. *longisporum* (Kühner) A. H. Sm. & Singer, Pap. Michigan Acad. Sci. 30: 114. 1945.
C. longisporum (Kühner) Heinem. & Thoen, Bull. Trimestriel Soc. Mycol. France 89: 16. 1973.
? *C. amianthinum* var. *sublongisporum* Singer in A. H. Sm. & Singer, Pap. Michigan Acad. Sci. 30: 112. 1945.

Pileus 10-25 mm, convex to plano-convex, rarely campanulate or obtusely conical; cinnamon-buff, honey-yellow, yellowish cinnamon; often with umbo, granulose, warts usually darker than background. **Lamellae** adnexed to adnate; juv. whitish, faintly cream, ad. buff to yellowish buff, crowded. **Stipe** 30-70 x 2-4 mm, at apex yellowish buff to sienna and silky striate; with floccose-scaly ring zone; below brown to dark brown, covered with flocks, might be glabrous with age. **Context** in pileus with yellow tinge near the surface and pale ochre below, in stipe brownish. **Odour** slightly to distinctly unpleasant. **Basidiospores** (5.0-) 6.0-7.5 (-9.0) x 3.0-3.5 (-4.0) µm, Q = 1.73-2.27, oblong to fusiform, amyloid. **Basidia** clavate, 4-spored, 19-28 x 5-6 µm. **Cheilocystidia** absent. **Sphaerocysts** darkening in KOH, cinnamon or rusty. **Arthrospores** in the upper part of pileus context below the sphaerocysts layer are common and abundant, 6-10 x 4-5 µm.

Habitat coniferous and mixed forests, on soil among moss and litter, August-October, rare to common.

General distribution. Europe: DEN, FIN, GBR, ICE, NOR, SWE; BGM, GER; FRA; EST, LAT, RUC, RUN, UKR. **Northern N-America.**

Remarks. *C. jasonis* is characterized by brownish-yellow pileus and amyloid oblong to fusiform basidiospores. *C. amianthinum* features a lighter colour of the basidiocarps, shorter and narrower basidiospores, as well absent or scattered arthrospores in the pileus context. *C. saarenoksae* is distinguished by smaller granules on the pileus surface, pale brown cap context, absence of arthrospores, and somewhat shorter and wider basidiospores; it grows on acid rock outcrops and in fens and bogs.

Specimens examined. Europe. EST. Harju Co.: Külvandu, 18.09.58, Kalamees (TAA 50576), Naissaar, 05.10.01, Saar (TAA 182058, 182059); Hiiu Co., Mäeselja, 16.09.01, Saar, Ploompuu (TAA 182042, 182045); Lääne-Viru Co.: Raeküla, 08.08.58, Kalamees (TAA 70966), Kolja, 16.09.59, Kalamees (TAA 51271); Põlva Co.: Veskimõisa, 14.09.59, Kalamees (TAA 71363), Saesaare, 10.09.61, Kask (TAA 263100); Pärnu Co.: Rannametsa, 28.08.89, Kytövuori (H); Tartu Co.: Palupõhja, 23.10.97, Vaasma (TAA 171716), Ahunapalu, 07.09.99, Saar (TAA 147402), Kaagvere, 11-16.10.99, 15.10.00, 01.09.01, Saar (TAA 147436, 147439, 147441, 147442, 147451, 147452, 147453, 147454, 147456, 147457, 147458, 182018, 182030), Metsanurga, 16.10.99, Saar (TAA 147445), Vooremägi, 17.10.99, Saar (TAA 147468), Kurepalu, 21.09.00, Kalamees (TAA 182013); Valga Co.: Hargla, 17-18.10.96, Kalamees (TAA 147294, 147295, 147296, 147514), Aakre, 30.07.98, Vaasma (TAA 171909); Võru Co.: Meeksi, 30.09.97, Saar; Kalamees (TAA 147336, 147338, 147840). **LAT.** Straume, 07.10.97, Kalamees (TAA 147879); Renceni, 07.10.97, Kalamees (TAA 147883); Saule, 08.10.97, Kalamees (TAA 147885); Mernieki, 10.10.97, Kalamees (TAA 147899). **FIN.** EH: Lammi, Evo, 06.09.78, Korhonen, Tuomikoski (H), Kangasala, 10.10.97, Rantala (TAA 147374), Tampere, 01.11.97, 22.08.98, Rantala, Saar (TAA 147378, 147390), Ruovesi, 17.09.99, Saar (TAA 147408, 147409, 147410, 147411, 147413, 147414), Kovero, 13.09.99, Saar (TAA 147403), Siikaneva, 14.09.99, Saar (TAA 147404, 147405); EP: Kurikka, 15.09.82, Kytövuori 82378 (H); Ks: Oulanka, 28.08.77, Korhonen, Tuomikoski (H), Oulanka, 09.09.81, Kalamees, Ohenoja, Ulvinen (TAA 122054); Kn: Ristijärvi, 01.09.80, Kytövuori 80644 (H), Kuhmo, 03.09.80, Kytövuori (H); PH: Kinnula, 18.09.82, Kytövuori 82448 (H); PK: Koli, 03.09.81, Bresinsky (REG); U: Tamminsaari, 19.09.78, Korhonen 2358, Tuomikoski (H), Sipoo, 23.09.78, 23.09.79, Saarenoksa 30978, 62779 (H), Mäntsälä, 19.09.80, Kytövuori 801071 (H), Helsinki, Annala, 27.09.81, Saarenoksa 57481 (H), Teissala, 08/13.10.97, Höijer (TAA 147380, 147383); V: Sauvo, 27.09.80, Kytövuori 801139 (H), Raulahti, 24.09.81, Tuomikoski (H), Välimäki, 09.10.81, Tuomikoski (H), Kuusisto Island, 02.09.92, Vauras 7106F (H). **NOR.** Finnm: Sture-Eckerøy, 19.08.81, Kalamees (TAA 121825); Troms: Brennfjell, 26.08.98, Öpik, Saar (TAA 147393); S&F: Suphelledalen in Fjærland, 10.09.00, Saar (TAA 147496), Skadhaug above Hermansverk, 11.09.00, Saar (TAA 182002, 182004, 182006, 182007, 182008). **GER.** Oberbayern, Geltendorf, 20.10.73, Bresinsky (REG); Böhmerwald, 08.10.81, Bresinsky (REG); Böhmerwald, 1150 m, 09.10.81, Bresinsky (REG); Rosengarten b. Bergmatting, 05.11.81 (REG); Etterzhausen, 18.10.84, Besl (REG); NP. Bayerischer Wald: 18.09.86, Luschka 321, Schwarzach, 15.09.85, Bresinsky, Luschka (REG), Guglöd, 20.09.85, Bresinsky (REG); Fichtelgebirge: Wülfersreuth, MTB: 5936/2, 30.09.85, Paulus 352 (REG), Oberwarmensteinach, MTB: 6036/2, 01.10.85, Paulus 354 (REG), Fichtelsee-Moor, MTB: 5937/3, 01.10.85, Paulus 353 (REG), Hiebsbadquelle b. Schönlind, MTB: 5937/1, 09.10.85, Paulus 382 (REG), Fichtelberg-Neugrün, MTB: 6037/1, 18.09.86, Paulus 1122 (REG); Sylt, Dünen b. List, 22.11.86, Bresinsky (REG); SW Kürn, 20.09.88 (REG); Rothenfelder Forst b. Hemdring, 23.09.89, Bresinsky (REG); S Alkofen KEH, 25.09.89, Besl 99/89 (REG); Paintner Forst, MTB: 7037/1, 28.09.89, Aicher, Reisinger R542/89 (REG); Bremeschlag, MTB: 6938, 12.10.89, Reisinger R688/89 (REG); Scheuchenberg, 14.10.89, Bresinsky (REG).

7. *Cystoderma lilacipes* Harmaja, Karstenia 18: 29-30. 1978.

Syn.: *C. longisporum* (Kühner) Heinem. & Thoen var. *purpurascens* Heinem. & Thoen, Bull. Trimestriel Soc. Mycol. France 89: 18. 1973.

Pileus 10-40 mm, convex to plano-convex, pale to dark brown, might be reddish brown; often with umbo, finely granulose; margin at first with veil remnants. **Lamellae** pale brown or ochre, adnexed or adnate, crowded. **Stipe** 30-90 x 3-6 mm, at apex with violet or purple shade and silky striate; with evanescent floccose-scaly ring zone; below reddish brown to almost blackish, covered with dark brown flocks. **Context** in pileus pale brown. **Odour** absent. **Basidiospores** (5.0-) 6.0-7.0 (-8.0) x 3.0-4.0 (-4.5) µm, Q = 1.68-2.22, oblong to fusiform, amyloid. **Basidia** clavate, 4-spored, 19-25 x 5-7 µm. **Cheilocystidia** absent. **Sphaerocysts** darkening in KOH, rusty. **Arthrospores** rare in the upper part of pileus context.

Habitat coniferous and mixed forests, on acid rock outcrops, on soil among moss and litter, September-November, rare.

General distribution. Europe: FIN; BGM, as *C. longisporum* var. *purpurascens*. **Northern America:** QUE.

Remarks. *C. lilacipes* is characterized by rather small brown basidiocarps and by violet or purple shades at stipe apex. This species grows on siliceous rock outcrops, often associated with *C. saarenoksae*. The other brown species *C. granulosa* features smaller inamyloid basidiospores.

Specimens examined. Europe. FIN. EH: Kangasala, 09/19.10.97, Kosonen (TAA 147363, 147362); EK: Vehkalahti, Turkia, acid rocky outcrops in *Larix* plantation, on/among *Polytrichum juniperinum*, 01.10.77, Fagerström (**holotype**, H), Vehkalahti, Pyhältö, 25.09/ 02.10.81, Fagerström (H); St: Yläne, SW of Vaskijärvi lake, 22.10.95, Vauras 11130 (TAA); U: Kirkkonummi, 13.10.79, 04.10.80, Saarenoksa 74579, 66980, 67080 (H), Kirkkonummi, Evitskog, 17.10.79, Korhonen, Saarenoksa 76779, 76879, 76979 (H), Helsinki, Kumpula-Toukola, 09.10.80, Saarenoksa 70780 (H), Helsinki, Vanhakaupunki, 13.10.80, Saarenoksa 72080 (H), Helsinki, Mustikkamaa, 17.10.80, Saarenoksa 73780 (H), Helsinki, Viikki, 04.10.81, Saarenoksa 60681 (H), Helsinki, Kumpula, 22.10.81, Korhonen 4330 (H), Porvoo, Teissala, 29.09.82, 13.10.97, Höijer (H; TAA 147382), Porvoo, Sondby, 10.10.82, Höijer (H), Nurmisjärvi, Uusikylä, 22.10.82, Toivonen, Askola 1170 (H), Vantaa, Puistola-Hakkila, 30.09.83, Kytövuori 83581 (H), Sipoo, Östersundom, 15.10.83, Saarenoksa 51083, 53983, 52983 (H), Helsinki, Herttoniemi, 06.11.83, Kytövuori 83678 (H), Sipoo, Kitö, 25.09.89, Kytövuori 89-1251 (H), Vantaa, Tammisto, 14.10.90, Saarenoksa 42490 (H), Vahterpää, 10.10.92, Kytövuori 92-3015 (H); V: Värtanfjärd, 27.09.61, Malmström, Harmaja (H), Rymättylä, Raulahti, 22.10.81, 07.11.82, 26.09/ 09.10.83, Tuomikoski (H), Korppoo, 18.09.89, Vauras 4176F (H).

8. *Cystoderma niveum* Harmaja, Karstenia 25: 41-42. 1985.

Syn.: ? *C. longisporum* (Kühner) Heinem. & Thoen var. *blanche* Heinem. & Thoen, Bull. Trimestriel Soc. Mycol. France 89: 20. 1973.

Basidiocarp white. **Pileus** up to 20 mm, campanulate to conical, later convex to plano-convex; granulose, margin at first with remnants of veil. **Lamellae** slightly sinuate or almost decurrent, rather thin; usually pinkish, rarely hyaline or whitish, crowded. **Stipe** 20-30 x 1-3 mm, at apex silky striate, with evanescent floccose-scaly ring zone, below covered with flocks. **Context** white. **Basidiospores** 6.0-7.0 (-8.0) x 3.0-4.0 µm, Q = 1.98-2.12, oblong to fusiform, amyloid. **Basidia** clavate, 4-spored, 20-22 x 5-6 µm. **Cheilocystidia** absent. **Sphaerocysts** hyaline in KOH.

Habitat coniferous and mixed forests, on acid rock outcrops, always on moss, October, rare.

General distribution. Europe: FIN.

Remarks. *C. niveum* is characterized by rather small white basidiocarps and amyloid basidiospores. The other white species *C. ambrosii* features smaller inamyloid basidiospores. Its closest congeneric relative appears to be *C. saarenoksae* (Harmaja, 1985).

Specimens examined. Europe. FIN. U: Helsinki, Viikki: Hakala, 19.10.85, Saarenoksa 52585 (H), Hakala, 11.10.87, Saarenoksa 41387 (dupl. 3, O 153866), 12.10.87, Saarenoksa 42587 (H).

9. *Cystoderma saarenoksae* Harmaja, Karstenia 25: 41. 1985.

Pileus up to 25 mm, yellowish brown, fulvous, finely granulose, margin at first with remnants of veil. **Lamellae** adnate or slightly decurrent, yellowish to yellowish buff, crowded. **Stipe** 30-90 x 3-6 mm, at apex with yellowish shade and silky striate; with evanescent floccose-scaly ring zone; below concolorous with pileus, covered with flocks. **Context** in pileus very pale brown. **Basidiospores** (5.0-) 6.0-7.0 (-8.0) x 3.0-4.0 (-4.5) µm, Q = 1.67-2.14, oblong to fusiform, amyloid. **Basidia** clavate, 4-spored, 18-25 x 5-7 µm. **Cheilocystidia** absent. **Sphaerocysts** darkening in KOH, cinnamon.

Habitat coniferous and mixed forests, on acid rock outcrops, always on moss, September-November, rare.

General distribution. Europe: FIN.

Remarks. *C. saarenoksae* is closely related to *C. jasonis* and especially to *C. lilacipes*. *C. jasonis* features slightly longer and narrower basidiospores and an abundance of arthrospores in the upper part of pileus context, whereas *C. lilacipes* is characterized by the brown-shade pileus, violet or purple stipe apex and longer basidiospores.

Specimens examined. Europe. FIN. EH: Kangasala, Ruutana, 28.09.87, Kosonen, Lähdeaho (H), 19.10.97, Kosonen (TAA 147361); EK: Vehkalahti, Pyhältö, 24.09.81, Fagerström (H); U: Helsinki, Vanhakaupunki, 27.09.81, Saarenoksa 57681 (H), Helsinki, Viikki, 04.10.81, 19.10.85, 13.09.86, 17.09.87, Saarenoksa 61481, 61181; 53685; 29186; 29587 (H), Helsinki, Kumpula-Toukola, 12.10.81, Saarenoksa 63281, 63381 (H), Pornainen, Laukkoski, 26.10.82, Vitikainen 10347 (H), Tuusula, 30.09.83, Kytövuori 83600 (H), Vantaa, Nybygget, 15.10.83, Saarenoksa 53183, 53283, 53383 (H), Helsinki, Herttoniemi, 06.11.83, Kytövuori 83680 (H), Helsinki, Puotinharju, 06.10.84, Saarenoksa 42884, 43884, 43984 (H), Helsinki, Mustikkamaa, 13.09.87, Saarenoksa 28487 (H), Helsinki, Mustavuori, 18.10.87, Saarenoksa 43087 (H), Porvoo, Vaarlahti, 07.11.83, Höijer (H), Sipoo, Hindsby, 15.10.83, Saarernoksa 51283, 52583 (H), Sipoo, Kitö, 25.09.89, Kytövuori 89-1252 (H); V: Rymättylä, Raulahti, 06-07.11.82, 02.10.83, Tuomikoski (H), Rymättylä, Välimäki, 08.11.82, Tuomikoski (H), Salmi, 12.10.89, Kytövuori 891482 (H).

10. ***Cystoderma superbum*** Huijsman, Fungus 26: 39-42. 1956.

Syn.: ? *C. haematites* (Berk. & Broome) Kühner & Maire, Bull. Trimestriel Soc. Mycol. France 50: 14. 1934.

Pileus 20-55 mm, convex then expanded, often depressed at centre, granulose, wine-purplish to purplish red, vinaceous purple, margin at first with remnants of veil. **Lamellae** adnate to adnexed, cream or with purple tinge, crowded. **Stipe** 35-60 x 4-8 mm, at apex concolorous with pileus, sometimes paler - bluish purple, silky striate; with evanescent floccose-scaly ring zone; below concolorous with pileus, covered with flocks. At first stuffed, becoming tubular, the basis often slightly enlarged downwards. **Context** pale purple. **Odour** absent. **Basidiospores** 4.0-5.0 (-5.5) x (2.5-) 3.0-3.5 µm, Q = 1.25-1.87, ellipsoid, inamyloid or amyloid only at suprahilar zone. **Basidia** clavate, 4-spored, 17-21 x 5-6 µm. **Cheilocystidia** absent. **Sphaerocysts** darkening in KOH, reddish brown, covered with incrusting pigment.

Habitat often clustered. In coniferous and mixed forests, on litter, August-October, rare.

General distribution. Europe: GBR; BGM, GER, SWI; FRA; ITA; BLR, KRY, RUN, UKR. **Asia-Temperate:** KRA.

Remarks. *C. superbum* is characterized by the purplish colour of its basidiocarps. The other purplish coloured species, *C. haematites*, features larger basidiospores as compared to *C. superbum* (Huijsman, 1956). According to Pegler & Young (1971), the entire spore wall is weakly grey amyloid, except for the suprahilar zone, which is strongly amyloid. The spore walls of the examined specimen were rather inamyloid and a strongly amyloid suprahilar zones was not observed.

Specimen examined. Europe. GER. Hessen, Dünsberg bei Giessen, 10.76 (REG).

11. ***Cystoderma tuomikoskii*** Harmaja, Karstenia 19: 27. 1979.

Pileus 20-35 mm, convex, plano-convex, fulvous brown, finely granulose, margin at first with remnants of veil. **Lamellae** buff on herbarium specimens, adnate or adnexed, crowded. **Stipe** 50 x 3 mm, thick, at apex whitish and silky striate; with well-developed persistent membranous ring; below concolorous with pileus, covered with flocks. **Context** whitish. **Basidiospores** 5.0-7.0 x 3.5-4.0 µm, Q = 1.25-1.75, broadly ellipsoid to ellipsoid, amyloid. **Basidia** clavate, 4-spored, 23-25 x 5-7 µm. **Sphaerocysts** in KOH pale cinnamon.

Habitat spruce forest, on soil among moss and litter, August, rare.

General distribution. Europe: FIN. **Asia-Temperate:** KRA, YAK.

Remarks. *C. tuomikoskii* is characterized by its persistent membranous ring and the large amyloid basidiospores. The similar brown-coloured species with persistent ring, *C. fallax*, features smaller basidiospores, whereas *C. arcticum* is distinguished by larger basidiospores.

Specimen examined. Europe. FIN. Ks: Kuusamo, Juuma, 23.08.74, Tuomikoski (**holotype**, H).

12. *Cystodermella adnatifolia* (Peck) Harmaja, Karstenia 42: 45. 2002.

Syn.: *Lepiota adnatifolia* Peck, Bull. New York State Mus. Nat. Hist. 54: 947. 1902.
Cystoderma granulosum (Batsch: Fr.) Fayod var. *adnatifolium* (Peck) A. H. Sm. & Singer, Pap. Michigan Acad. Sci. 30: 90. 1945.
C. adnatifolium (Peck) Harmaja, Karstenia 14: 122. 1974.

Pileus 20-80 mm, convex to plano-convex, then expanded, brownish apricot, brownish orange, orange buff, sometimes with umbo, granulose, margin at first with remnants of veil. **Lamellae** white, adnexed to adnate, crowded. **Stipe** 25-70 x 5-10 mm; at apex whitish and silky striate; with evanescent floccose-scaly ring zone; below concolorous with pileus, covered with white flocks, sometimes with a few red granules added, consisting of sphaerocysts and occurring usually only on basis of stipe. The basis often is enlarged downwards. **Context** white to whitish. **Odour** absent or slightly unpleasant. **Basidiospores** (3.5-) 4.0-4.5 (-5.0) x (2.0-) 2.5-3.0 µm, Q = 1.49-1.98, ellipsoid to oblong, inamyloid. **Basidia** clavate, 4-spored, 18-29 x 4-6 µm. **Cheilocystidia** absent. **Sphaerocysts** darkening in KOH, cinnamon.

Habitat coniferous and mixed forests, on soil among moss and litter, August-October, rare to scattered.

General distribution. Europe: DEN, FIN, NOR, SWE; GER; EST, LAT, RUW. **Asia-Temperate:** IRK. **Northern N-America.**

Remarks. *Cystodermella adnatifolia* is characterized by the orange-shade pileus and the inamyloid basidiospores. The similarly orange coloured basidiomes of *C. cinnabarina* have spear-like cheilo- and pleurocystidia. *C. granulosa* features brown-shade pileus and its basidiocarps are often smaller. The basidiospores of these two species are shorter and narrower.

Specimens examined. Europe. EST. Harju Co.: Naissaar, 05.10.01, Saar (TAA 182056, 182057); Hiiu Co.: Puski, 14.09.01, Kollom (TAA 128269), Mäepe, 15.09.01, Vaasma (TAA 182040); Põlva Co.: Koorvere, 28.09.59, Kalamees (TAA 71431), Nohipalo, 13.09.00, Kalamees (TAA 175640); Tartu Co.: Laeva, 23.10.97, Vaasma (TAA 171701), Järvselja, 24.08.98, Kalamees, Vaasma (TAA 172000), Kaagvere, 10-11.10.99, 01.09.01, Saar (TAA 147418, 147430, 147431, 182029), Kammeri, 08.09.01, Kullman (TAA 182031); Võru Co.: Obinitsa, 25.08.81, Paas (TAA 182023), Meeksi, 30.09.97, Kalamees, Saar (TAA 147843, 147846, 147335, 147339, 147340, 147341), Uigumäe, 01.10.97, Saar (TAA 147343). **LAT.** Kemeri National Park, 24.09.96, Kalamees (TAA 147009); Renceni, 07.10.97, Kalamees (TAA 147881); Maczalaca, 09.10.97, Kalamees (TAA 147895). **FIN.** A: Lemland, 17.08.74, Hæggström (H); EH: Lammi, 24.09.77, Tuomikoski (H), Tampere, 10.10.97, Rantala (TAA 147356, 147357), Pirkkala, 10.10.97, Lenkoaho (TAA 147366), Nokia, 17.10.97, Kosonen (TAA 147360), Tampere, 01.11.97, Rantala (TAA 147375); EK: Vehkalahti, 04.10.70, Fagerström (H), Kaipiainen, 15.09.94, Kytövuori 94-531 (H); ES: Punkaharju, 20.08.56, Tuomikoski (H), Punkaharju, 20.09.81, Kytövuori 811445 (H), Taipalsaari, 16.09.89, Kytövuori 89-918 (H), Mäntyharju, 29.09.94, Kytövuori 94-1087 (H); Kn: Paltamo, 29.08.81, Kytövuori (H); Ks: Oulanka, 30.08.77, Korhonen, Tuomikoski (H), Liikasenvaara, 04.09.81, Kytövuori 811135 (H), Liikasenvaara, 10-11.09.81, Kalamees (TAA 122115, 122162); PK: Koli, 03.09.81, Bresinsky (REG), Kaavi, 29.08.85, Kytövuori 85545 (H); PS: Kiuruvesi, 19.09.82, Kytövuori 82497 (H), Nilsiä, 08.09.83, Kytövuori 83229 (H), Maavesi, 31.08.85, Kytövuori 85595 (H); SoL: Tähtelä, 24.08.92, Kytövuori 92-957 (H), Viitaranta, 25.08.92, Kytövuori 92-1017 (H), Sadankylä, 27.08.92, Kytövuori 92-1155 (H); U: Nurmijärvi, 13.09.87, Askola 2227 (H), Porvoo, 09.10.97, Höijer (TAA 147381), Askola, 13.10.97, Höijer (TAA 147385); V: Karkkila, 22.09.79, Kytövuori 79864 (H). **GER.** Kelheim, 07.10.74, Bresinsky (REG); Etterzhausen, 06.08.81, Besl 45/81 (REG). **Asia-Temperate. IRK.** Bratsk, 22.08.83, Kalamees, Kovalenko (TAA 122989).

13. *Cystodermella ambrosii* (Bres.) Harmaja, Karstenia 42: 45. 2002.
Syn.: *Armillaria ambrosii* Bres., Fungi trident. 1: 27. 1881.
Cystoderma ambrosii (Bres.) Singer, Ann. Mycol. 41: 170. 1943.

Pileus 20-55 mm, plano-convex to expanded, snow white when young, in age added cinnamon buff tinge; at first covered with small white conic scales formed by sphaerocysts and hyphae, in age more or less glabrescent or appearing cottony-fibrillose. **Lamellae** white or with cream tinge, adnate to adnexed, crowded. **Stipe** 50-90 x 5-12 mm, white, at apex silky striates; with evanescent floccose-scaly ring zone, below covered with flocks. **Context** whitish. **Odour** absent. **Basidiospores** 4.0-5.0 x (2-) 2.5-3.0 µm, Q = 1.54-1.94, ellipsoid to oblong, inamyloid. **Basidia** clavate, 4-spored, 20-25 x 4-5 µm. **Cheilocystidia** absent. **Sphaerocysts** hyaline to very slightly yellowish in KOH, pileipellis consist filamentous hyphae in addition to sphaerocysts. Remnants of veil consisting of sphaerocysts and filamentous hyphae.

Habitat coniferous and mixed forests, on soil among moss and litter, August-October, rare.

General distribution. Europe: DEN, FIN; AUT, BGM, GER, HUN, SWI; FRA; ITA; BLR, RUW, UKR. **Asia-Temperate:** KRA; KGZ; NCS. **Northern N-America.**

Remarks. *Cystodermella ambrosii* is characterized by white coloured basidiocarp, inamyloid basidiospores and colourless sphaerocysts in KOH. *Cystoderma carcharias f. alba* (Fr.) A. H. Sm. & Singer features amyloid basidiospores and persistent ring. *C. niveum* is separated by its amyloid, oblong to fusiform basidiospores.

Specimens examined. Europe. FIN. EH: Lammi, 07.09.70, 03.09.81, 29.08.88, Vänskä 67738 (H), 05.09.72, Vänskä, Tuomikoski (H), 06/ 10.09.75, Tuomikoski (H); ES: Taipalsaari, 10.10.70, Vitikainen 5762 (H); Ks: Juuma, 23.08.74, Ulvinen (H). **GER.** Bayern, Bad Wörishofen, 09.11.72, Stangl (REG).

14. *Cystodermella granulosa* (Batsch : Fr.) Harmaja, Karstenia 42: 46. 2002.
Syn.: *Agaricus granulosus* Batsch: Fr., Syst. mycol. I: 24. 1821.
Lepiota granulosa (Batsch: Fr.) Gray, Nat. Arr. Br. Pl. I: 602. 1821.
Cystoderma granulosum (Batsch : Fr.) Fayod, Ann. Sci. Nat. Bot., sér. VII 9: 351. 1889.

Pileus 15-40 mm, convex to plano-convex, rusty tawny, brick-colour, cinnamon, greyish brown, fulvous-umber; often with umbo; granulose; margin at first with remnants of veil. **Lamellae** white, adnexed, adnate or deccurent tooth, crowded. **Stipe** 30-90 x 3-6 mm, at apex light brown and silky striate; with evanescent floccose-scaly ring zone; below concolorous with pileus, covered with whitish to dark brown flocks. **Context**, in pileus whitish, in stipe brownish. **Odour** absent or slightly unpleasant. **Basidiospores** (3.5-) 4.0-4.5 (-5.0) x 2.0-2.5 (-3.0) µm, Q = 1.62-2.05, oblong, inamyloid. **Basidia** clavate, 4-spored, 18-27 x 4-5 µm. **Cheilocystidia** absent. **Sphaerocysts** darkening in KOH, rusty. **Habitat** coniferous and mixed forests, on soil among moss and litter, July-October, common.

General distribution. Europe: DEN, FIN, GBR, ICE, IRE, NOR, SWE; AUT, BGM, GER, HUN, NET, POL, SWI; FRA, POR, SPA; GRC, ITA, ROM; BLR, EST, LAT, LIT, RUC, RUE, RUN, RUW, UKR. **Asia-Temperate:** ALT, BRY, KRA, TVA, WSB, YAK; KAM, MAG, PRM, SAK; KAZ; TCS; JAP. **Northern America:** ASK; BRC. **Southern America:** VEN. **Africa:** ALG, MOR.

Remarks. *Cystodermella granulosa* is characterized by its brown pileus and small inamyloid basidiospores. The other brown species *Cystoderma lilacipes* has violet or purple stipe apex and larger amyloid basidiospores.

Specimens examined. Europe. EST. Harju Co.: Valkla, 06.09.01, Ploompuu (TAA 182041), Naissaar, 06.10.01, Leenurm (TAA 182067); Hiiu Co.: Puski, 14.09.01, Kollom (TAA 182037); Ida-Viru Co.: Kassisare, 17.08.61, Kalamees (TAA 72586); Jõgeva Co.: Vooremaa, 22-23.09/ 02-03.10.72, Kalamees, Kollom (TAA 114037, 114061, 114200, 114036, 114288); Lääne-Viru Co.: Luusiku, 23.08.62, Kelder (TAA 73144); Põlva Co.: Kriisa, 07.10.72, Kalamees (TAA 80411), Akste, 08.09.01, Kullman (TAA 182032); Saare Co.: Audaku, 17.08.84, Kalamees (TAA 123631), Järve, 04.10.88, Kalamees, Vaasma (TAA 144045), Karjalasma, 12.08.98, Vaasma (TAA 171953); Tartu Co.: Vasevere, 04.10.63, Kalamees (TAA 74956), Kaagvere, 11.10.68, 10.10.99, 01.09.01, Kalamees; Saar (TAA 77626; 147424, 147425, 182028), Ahunapalu, 25.07.90, Kalamees (TAA 144672), Ihaste, 21.10.92, Kalamees (TAA 145644), Selgase, 23.07.98, Kalamees (TAA 147984), Metsanurga, 06.08.00, Saar (TAA 147491); Valga Co.: Karula, 25.08.82, Veldre (TAA 114912), Kihati, 26.09.83, Veldre (TAA 141198), Koikküla, 21.07.84, Veldre (TAA 123550), Hargla, 18.10.96, Kalamees (TAA 147500), Aakre, 04.08.98, Leenurm (TAA 147387); Võru Co.: Meeksi, 30.09.97, Saar, Kalamees (TAA 147337; 147849), Vällamägi, 02.10.97, Veldre, Kalamees (TAA 147344, 147867), Kütiorg, 03.10.97, Ohenoja (TAA 147352). **LAT.** Renceni, 07.10.97, Kalamees (TAA 147882); Vitrupe, 10.10.97, Kalamees (TAA 147901). **RUN.** Murmansk, Kandalaksa, 14.08.77, Kalamees, Pihlik, Vaasma (TAA 84047). **FIN.** EH: Tampere, 10.97, Rantala (TAA 147359), Pirkkala, 10.10.97, Lenkoaho (TAA 147369), Tampere, 22.08.98, Saar (TAA 147391), Hyytiälä, 17.09.99, Raitviir (TAA 147415); Ks: Liikasenvaara, 10.09.81, Kalamees, Ohenoja, Ulvinen (TAA 122127); U: Helsinki, Annala, 07.10.97, Höijer (TAA 147379). **NOR.** Troms: Brennfjell, 26.08.98, Saar (TAA 147392); S&F: Sogndal, 08.09.00, Saar (TAA 147492). **GER.** Oberbayern, Kaltenberg, 30.09.73, Bresinsky (REG); Etterzhausen, 25.09.81, Besl 142/81 (REG); Niederbayern, Offenstetten, 05.10.82, Besl, Bresinsky (REG); Schäftlarn, 06.09.83, Besl 48/83 (REG); Viehhausen, 04.10.92, Bresinsky (REG); Rammersberg, MTB: 6024/1, 08.11.94, 16.09.95, 28.10.96, Krieglsteiner 1448, 4715, 4385 (REG); NSG Astheimer Sande, MTB: 6127/2, 02.11.95, Krieglsteiner 2904 (REG). **Asia-Temperate. ALT.** Tjungur, 02.08.69, Kalamees (TAA 77949); Telezkoje, 12-15.08.69, Kalamees (TAA 78007, 78028). **KRA.** Kuznetskiy Alatau, 16/ 19.08.85, Kalamees (TAA 124041, 124134). **TVA.** Tannu-Ola Range, 10.07.72, Kullman (TAA 65679). **KAM.** Esso, 06.08.78, Kalamees, Kullman, Vaasma (TAA 120010). **Northern America. BRC.** Vancouver Island, Sooke, 16.10.62, Pantidou, Groves (TAA 92201).

15. ***Cystodermella cinnabarina*** (Alb. & Schwein.: Fr.) Harmaja, Karstenia 42: 45. 2002.

Syn.: *Agaricus granulosus* var. *cinnabarinus* Alb. & Schwein., Consp. Fung. Lusat.: 147. 1805.
A. cinnabarinus (Alb. & Schwein.: Fr.) Fr., Syst. mycol. III: Index: 12. 1832.
A. terreii Berk. & Broome, Ann. Mag. Nat. Hist. 4 (6): 462. 1870.
Lepiota cinnabarina (Alb. & Schwein.: Fr.) P. Karst., Ryssl. Hattsvamp.: 14. 1879.
Cystoderma cinnabarina (Alb. & Schwein.: Fr.) Fayod, Ann. Sci. Nat. Bot., sér. VII 9: 351. 1889.
C. terreii (Berk. & Broome) Harmaja, Karstenia 18: 30. 1978.

Pileus 30-60 (80) mm, convex, plano-convex, brownish red, brownish orange, orange cinnamon, coral; often with umbo, granulose, margin at first with remnants of veil. **Lamellae** white, adnate or adnexed, crowded. **Stipe** 30-60 x 5-12 mm, at apex whitish and silky striate; with evanescent floccose-scaly ring zone, below concolorous with pileus, covered with flocks and reddish granules, consisting of sphaerocysts; the basis often is enlarged downwards. **Context** white to whitish. **Odour** absent. **Basidiospores** (3.5-) 4.0-4.5 (5.0) x 2.0-2.5 μm, Q = 1.60-2.03, ellipsoid to oblong, inamyloid. **Basidia**

clavate, 4-spored, 17-24 x 4-5 µm. **Cheilocystidia** always present. Cheilo- and pleurocystidia slightly ventricose below, tapering to a long, narrow neck with spear-shaped apex often covered with crystals. **Sphaerocysts** darkening in KOH, rusty.

Habitat coniferous and mixed forests, on soil among moss and litter, August-October, scattered.

General distribution. Europe: DEN, FIN, GBR, ICE, IRE, NOR, SWE; AUT, BGM, GER, HUN, NET, POL, SWI; FRA, SPA; ITA, ROM; BLR, EST, LAT, LIT, RUC, RUE, RUN, RUW, UKR. **Asia-Temperate:** ALT, BRY, KRA, IRK, YAK; AMU, KAM, PRM; KAZ; NCS; JAP. **Northern America:** ASK. **Africa:** ALG, MOR.

Remarks. *Cystodermella cinnabarina* is well characterized by the distinctive spear-like cheilocystidia that are absent in the similarly coloured *C. adnatifolia*.

Specimens examined. Europe. EST. Harju Co.: Salmistu-Kaberneeme, 14.09.97, Jürgens (TAA 147332), Rutja, 19.10.97, Kullman (TAA 147354, 147355), Naissaar, 04-06.10.01, Saar (TAA 182051, 182052, 182055, 182060, 182062, 182063, 182065, 182066); Hiiu Co.: Ristna, 09.10.94, Kalamees (TAA 146415), Puski, 14.09.01, Kollom (TAA 182036), Mäeselja, 16.09.01, Ploompuu (TAA 182043); Ida-Viru Co.: Jõetaguse, 07.08.61, Kalamees (TAA 72422); Jõgeva Co.: Mõisamaa, 04.09.60, Kalamees (TAA 71729), Siimuste, 20.09.60, Kalamees (TAA 71809), Kurista-Kõpu, 03.10.60, Kalamees (TAA 71972); Järva Co.: Noku, 14.09.58, Kalamees (TAA 50592), Huuksi, 20.09.95, Vaasma (TAA 142691); Lääne Co.: Dirhami, 06.10.93, Kalamees (TAA 146119), Marimetsa, 24.09.94, Kalamees, Saar (TAA 146430); Lääne-Viru Co.: Karepa, 27.07.98, 20.08.99, Kullman (TAA 157823, 179144, 179145), Kihelkonna, 14.08.98, Vaasma (TAA 171966); Põlva Co.: Taevaskoja, 08.09.57, Kalamees (TAA 70556); Pärnu Co.: Kabli, 23.09.90, Kalamees (TAA 144765), Ristiotsa, 27.09.94, Vaasma (TAA 142277); Saare Co.: Kihelkonna, 20.08.84, 14.08.98, Kalamees, Štšukin, Vaasma (TAA 123714, 171966), Selgase, 10.09.93, Kalamees, Salo, Liiv (TAA 145958), Audaku, 13.09.93, Kalamees, Vaasma (TAA 145991), Võhma, 16.09.93, Kytövuori 93-1328 (H); Tartu Co.: Kaagvere, 10.10.99, Saar (TAA 147417, 147423), Rõhu-Tõravere, 18.10.99, Kalamees (TAA 147479); Valga Co.: Piiri, 01.10.57, Kalamees (TAA 70768), Hargla, 30.07.96, Kalamees (TAA 146926); Võru Co.: Võru-Kubija, 25.09.57, Kalamees (TAA 70706), Vastseliina, 26.08.81, Paas (TAA 182024), Kütiorg, 03.10.97, Kalamees (TAA 171759). **LAT.** Straume, 07.10.97, Kalamees (TAA 147878). **RUW.** Novgorod, Valdai, 18.09.76, Pihlik, Vaasma (TAA 81193). **FIN.** EH: Kangasala, 10.10.97, Rantala (TAA 147370); Ks: Liikasenvaara, 10.09.81, Kalamees, Ohenoja, Ulvinen (TAA 122100); PeP: Tervola, 08.08.98, Nummela-Salo, Salo 5330 (H). **SWE.** Mpd: Borgsjö, 13.09.95, Kalamees (TAA 146655); Nb: Överkalix, 27.08.98, Saar (TAA 147394). **GER.** Etterzhausen, 05.09.77, 02.10.83, Besl 170/77, 126/83 (REG); Schwaighauser Forst, 06.10.84, Besl 208/84 (REG); Fichtelgebirge, MTB: 5936/4, 08.10.85, 23.09.86, Paulus 439, 1159 (REG); Girnitztal, 27.10.88, 10.10.89, Arnold, Reisinger R585/88, 136/89 (REG); n/Adelstein, 09.10.92, Steidel (REG); Coburger Raum, 12.10.93, Engel (REG); Otterbachtal b. Unterlichtenwald, MTB: 6939/2, 25.10.98, Besl (REG). **Asia-Temperate. ALT.** Ust-Konsa, 23.07.69, Kalamees (TAA 77837); Telezkoje, 11.08.69, Kalamees (TAA 77996); Reserv. Altay, 15.08.69, Kalamees (TAA 78029). **IRK.** Bratsk, 05.09.87, Kalamees, Astapenko (TAA 143630). **KRA.** Bolske-Murtinsk, 26.08.83, Kalamees, Vaasma (TAA 123002); Chakassia, Minusinsk, 13.08.85, Kalamees (TAA 123998). **KAM.** Esso, 05.08.78, Kalamees, Kullman, Vaasma (TAA 84967). **NCS.** Karacheyevo-Cherkessiya, Teberda State Biosphere, Baduk, 27.08.99, Kalamees (TAA 175189).

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SPERMOSPORINA GYMNADENIAE SP. NOV. ON GYMNADENIA SP. (ORCHIDACEAE)

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ABSTRACT: *Spermosporina gymnadeniae* sp. nov. is newly described from leaves of *Gymnadenia* sp. (Orchidaceae). It was collected in the Tatra Mts. (the Tatra National Park, Poland), and is known only from this locality. In this paper, the fungus is described in detail and compared to other *Spermosporina* species.

Key words: mycobiota, new species, mitosporic fungus, Poland

The mitosporic genus *Spermosporina* U. Braun, described by Braun (1993), consists of eight species occurring on 24 host plants belonging to six families. The species are distributed in temperate areas of Asia, Europe, and North America. The only exception is *Spermosporina phyllactidis* (Speg.) U. Braun, which is known from Argentina, South America. Its taxonomic position, however, is uncertain, and the taxon in only tentatively considered to belong to *Spermosporina* (Braun, 1995). A fungus collected in the Tatra Mts., Poland, in 1999 proved to represent a further species of *Spermosporina*, previously not described. The species is presented below.

Spermosporina gymnadeniae sp. nov. Fig. 1.

Maculae amphigenae, ellipticae-oblongae, 6-10 x 3-5 mm, atrobrunneae, deinde centro pallescens. Mycelium immersum; hyphae ramosae, septatae, subhyalinae; stromata minuta, 10-25 µm diam., interdum oblonga, ad 40 µm, vel confluentes, ex cellulis inflatis, 2-5 µm latis composita, substomatalia vel intraepidermalia, hyalina vel subhyalina. Coloniae amphigenae, conspicuae, punctiformes, griseo-albidae. Cellulae conidiogenae saepe dense aggregatae in sporodochiis minutis, interdum solitariae vel

in fasciculis minutis, ex cellulis stromatibus oriundae, per stoma emergentiae vel per cuticulam erumpentiae, interdum ovoideae, lageniformes vel obpyriformes, (6-)8-12(-16) x (2-)2,5-5(-6) _m, hyalinae, tenuitunicatae, leviae, locis conidiogenis inconspicuis (non-incrassatis, non-fuscatis). Conidia solitaria, raro catenulata, subcylindrica vel ellipsoidea-ovata, 10-20 x 1,5-2,5 _m (∅ 14 x 2 _m), (0-)1-septata, hyalina, levia, apice obtuso, basi obtusa, subacuta vel subtruncata.

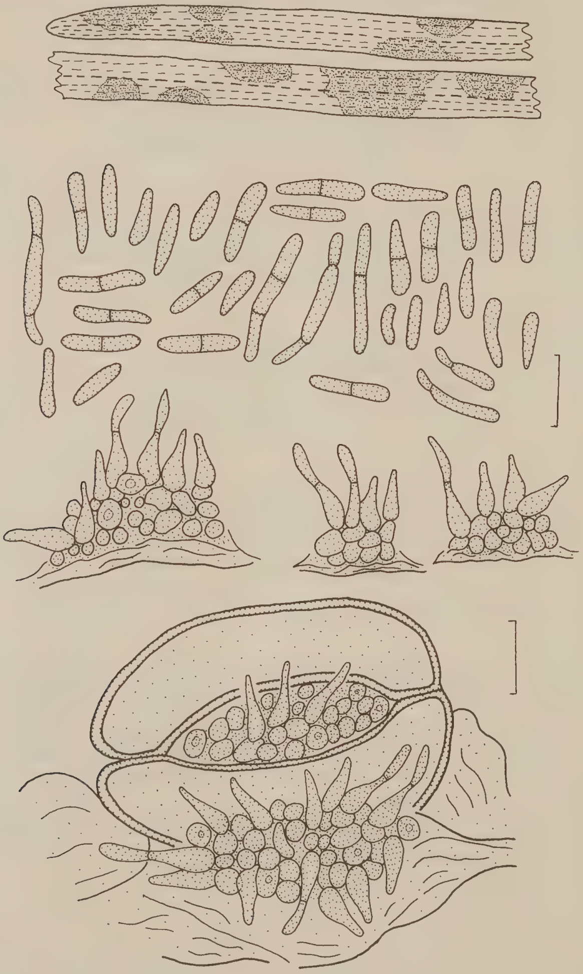

Fig. 1. *Spermosporina gymnadeniae* on the leaves of *Gymnadenia* sp. (i) leaf spots on leaf apex upper surface and lower surface of another leaf (± x 1), (ii) conidia, (iii) cross sections of hyphal aggregations (stromata), (iv) stromata with conidiophores emerging through stoma and erumpent through cuticle. Scale bars = 20 μm (W. Mulenko del.).

Leaf spots amphigenous, elliptical to elongated, 6–10 x 3–5 mm, dark brown, later developing a pale centre. Mycelium internal; hyphae branched, septate, subhyaline, forming small hyphal aggregations (stromata) in the substomatal cavities or epidermal cells, 10–25 µm diam., occasionally oblong, up to 40 µm long, or confluent, composed of swollen hyphal cells, 2–5 µm diam., hyaline or subhyaline (very faintly pigmented). Colonies amphigenous, conspicuous, punctiform, greyish white. Conidiogenous cells usually densely aggregated, forming small sporodochia, occasionally solitary or in small fascicles, arising from stromatic hyphal aggregations, emerging through stomata or erumpent through the cuticle, ovoid, lageniform or obpyriform, (6–)8–12(–16) x (2–)2.5–5(–6) µm, hyaline, thin-walled, smooth. Conidia solitary, rarely in short chains, subcylindrical to ellipsoid-ovoid, 10–20 x 1.5–2.5 µm (mean 14 x 2 µm), 1-septate, rarely aseptate, hyaline, smooth, apex and bas obtuse, subacute or subtrunacte (Fig. 1).

Holotype: on *Gymnadenia* sp. (Orchidaceae), Poland, Tatra National Park (the Koscieliska valley), mountain meadow, 15 June 1999, leg. A. Wolczanska and W. Mulenko (LBLM–8400). **Isotype**: HAL 1724.

Etymology: Epithet derived from the name of the host genus.

Host ranges, sizes of the conidiogenous cells and sizes and septation of the conidia of *S. gymnadeniae* sp. nov. as well as all other species of *Spermosporina* are compared in Table 1.

Tab. 1. Comparison of the species belonging to the genus *Spermosporina* (based on Braun, 1995).

***Spermosporina* species**	**Host plants (family)**	**Conidiogenous cells (µm)**	**Conidia (µm)**
Liliopsida (= Monocotyledones)			
S. alismatis (Oudem.) U. Braun	*Alisma* spp. (Alismataceae)	5–15 x 2–6	(8-)10-20(-24) x 2-4.5 0-2-septate
S. sagittariae (Bres.) U. Braun	*Sagittaria* spp. (Alismataceae)	5-28 x 2-5	(8-)15-22(-25) x (2-)2.5-4 (0-)1-2-septate
S. aricola U. Braun	*Arum maculatum* L. (Araceae)	5-15 x 2-5	8-16 x 2-3.5 0-1-septate
S. graminella (Höhn.) U. Braun	*Brachypodium* spp.; *Calamagrostis* sp.; *Molinia coerulea* (L.) Moench; *Phragmites australis* (Cav.) Trin. ex Steud.; *Poa bulbosa* L. (Poaceae)	10-25 x 3-7	13-23(-28) x 3-6(-7) 1-septate
S. graminicola (Peck) U. Braun	*Poa palustris* L. (Poaceae)	8-25 x 2-6	25-30(-35) x 3.5-6 1-septate
S. gymnadeniae sp. nov.	*Gymnadenia* sp. (Orchidaceae)	(6-)8-12(-16) x (2-)2.5-4	10-20 x 1.5-2.5 (0-)1-septate
Magnoliopsida (= Dicotyledones)			
S. sonchi-oleracei (Fautrey) U. Braun	*Sonchus* spp. (Asteraceae)	8-12 x 3-5	9-13 x 1.5-3 0-1-septate
S. magnusiana (Sacc.) U. Braun	*Trientalis* spp. (Primulaceae)	8-20(-25) x 3-8	13-28 x 2.5-6 0-2-septate
?*S. phyllactidis* (Speg.) U. Braun	*Phyllactis* sp. (Valerianaceae)	10-25 x 4-5	10-12 x 2.5-4 aseptate

Small sporodochia formed by the new species on *Gymnadenia* sp. bear resemblance to those in the genus *Microdochium* Syd. Species of the latter genus, however, are characterised by cells that proliferate either sympodially (subgen. *Microdochium*) or percurrently [subgen. *Gerlachia* (W. Gams & E. Müller) U. Braun, 1995]. The conidiogenous cells in the fungus on *Gymnadenia* sp. are consistently unilocal, and more likely to occur in *Spermosporina.*

Spermosporina species are specialized phytopathogenic fungi with narrow host ranges, not exceeding a single plant family (Braun, 1995). The small size of conidiogenous cells indicates that *S. gymnadeniae* sp. nov., the first species on a host of the Orchidaceae, is morphologically close to *S. alismatis*, *S. aricola*, and *S. sonchi-oleracei*; unlike them, however, it has small, well-developed sporodochia. Furthermore, the species described has much longer and narrower conidia, especially in comparison with *S. alismatis* and *S. aricola*, which have wider conidia.

ACKNOWLEDGEMENTS

The authors express thanks to Prof. P. W. Crous, Fungal Biodiversity Center – Utrecht, The Netherlands, for critical comments on the manuscript, and for acting as a presubmission reviewer.

REFERENCES

Braun, U. (1993). New genera of phytopathogenic hyphomycetes. Cryptog. Bot. 4: 107-114.

Braun, U. (1995). A monograph of *Cercosporella, Ramularia* and allied genera (phytopathogenic hyphomycetes) vol. 1. IHW – Verlag, Eching bei München.

MYCOTAXON

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BOOK REVIEWS AND NOTICES

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GENERAL

Fungal Populations and Species. By John Burnett. 2003. Oxford University Press, Great Clarendon Street, Oxford OX2 6DP, UK. Pp. xiii + 348. ISBN 0 19 851552 9 (hardback), 0 19 851553 7 (paperback). Price £ 80 (hardback), £ 37.50 (paperback).

The issues surrounding the genetics of populations and species, and the application of species concepts, are amongst the hottest topics in molecular mycology today. The field is fast moving, but also in need of in-depth syntheses as the volume of pertinent literature rises exponentially. This book, by one of our most experienced fungal geneticists, is therefore both timely and welcome. It endeavours to do two things, to make geneticists and population biologists more aware of what happens in fungi, and to provide a synthesis of where we currently are in understanding these fundamental aspects of our subject.

The chapters are arranged in four main parts: Basic mycology, Methodology, Processes in populations, and Species and speciation. The contents are broken down to the lowest order subheadings. This is seldom seen in books today, but facilitates familiarization with the structure of the text and the location of material on particular topics. Original sources are quoted throughout the text, and while these are compiled at the end of the book, each chapter concludes with a helpful 'Further reading' section divided into two parts, general and specific.

Another innovation is the inclusion in square brackets, after each mention of every scientific name, of a code to indicate the main group of fungi to which the taxon belongs; for example '*Sordaria* [AP]' indicates that this genus is an ascomycete with perithecia.

The emphasis is on processes as seen from the genetical standpoint, rather than the practical problems of species definitions. Species concepts are reviewed, but in only 20 pages it was clearly impractical to cover the full diversity of species concepts now proposed (*cf.* Wheeler & Meier 2000). I would have like to see the 'pragmatic' species concept considered as well as more theoretical ones, and the review of Grube & Kroken (2000) discussed.

The work is lucidly written, well-presented, and illustrated by clear line drawings. It should be studied by all mycologists working around the species level, whether from systematic or applied standpoints. However, in common with all works of complexity there are the inevitable slips, though in this case the keen eye of a systematist could have been sought. Examples are the references to the phylum names *Hyphochytriomycota* and *Oomycota* as 'families' (p. 6); the lichen *Parmelia plittii* coded as a lichenicolous fungus; *Acremonium* being given as a synonym of *Neotyphodium*; and the use of *Ophiostoma novo-ulmi* and *O. ulmi* in reference to the same information (p. 67). Many mycologists will also be sad to see the use of the category 'Fungi anamorphici' in the outline classification adopted, which dos not follow Kirk *et al.* (2001) as claimed (p. 332).

While slips that could have been avoided irritate, they are a small price to pay for the pleasure of having such a work to hand. It deserves to be a mycological best-seller, and should be a priority purchase order for universities and research centres concerned with evolutionary or population biology or genetics, as well as with mycology.

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[1] Books for consideration for coverage in this column should be mailed to the Book Review Editor (address above) in the first instance. Fax (+34) 91 857 3640; e-mail: myconova@terra.es.

Grube, M. & Kroken, S. (2000) Molecular approaches and the concept of species and species complexes in lichenized fungi. *Mycological Research* **104**: 1284-1294.

Kirk, P. M., Cannon, P. F., David, J. C. & Stalpers, J. (2001) *Ainsworth & Bisby's Dictionary of the Fungi.* 9th edn. Wallingford: CABI Publishing.

Wheeler, Q. D. & Meier, R. (eds) (2000) *Spcies Concepts and Phylogenetic Theory.* New York: Columbia University Press.

Biogeograhical relationships between Fungi and selected glacial relict Plants. By Andrzej Chlebicki. 2002. Polish Botanical Society, Al. Ujazdowskie 4, PL-00478 Warsaw, Poland. [Monographiae Botanicae No. 90.] Pp. 230, figs 46, tables 21. ISBN 83 86292 62 8. Price: Not indicated.

Host-focussed studies of fungi associated with particular plants are always welcome as aids to both determination and distributional studies. This work examines the fungi associated with, and generally confined to, 24 flowering plants that are interpreted as glacial relicts, with a view to determining which sites are the longest established. A staggering 1329 localities throughout the arctic-boreal zone yielded 254 species of fungi on these hosts. However, only six hosts yielded sufficient records for more detailed analysis: *Chamaedaphne calyculata, Dryas intermedia, D. octopetala, Empetrum hermaphroditum, E. nigrum,* and *Rubus chamaemorus*. The high arctic was most important for dryads, and migration routes of the plants are posited from the fungal data. Some fungi were widely distributed while others had narrower ranges. Four new species were discovered and are described and illustrated here (*Lachnum uralens, Leptosphaerulina sibirica, Melanomma margaretae,* and *Tiaspora pirozynskii*). Some other species are named to genus only and merit further study. Much other information, and line drawings, are included for many species. This is a major contribution to our knowledge of arctic microfungi and a taste of the kinds of questions posed by plant biogeographers that merit testing by fungal data sets. The types of data generated from such studies also have the potential to provide an extra dimension to conservationists in determining the most important sites for the protection of the host plants.

Schimmelpilze und deren Bestimmung. By Liliane E. Petrini & Orlando Petrini. 2002. J. Cramer in der Gebrüder Borntraeger Verlagsbuchhandlung, D-14129 Berlin. [Bibliotheca Mycologica No. 194.] Pp. 137 plus index. ISBN 3 443 59096 9. Price: € 38.

There seems to be an ever-increasing awareness in German-speaking countries of the potential health hazards associated with moulds, and the book market has been quick to respond (e.g. Reiss 1998; Mücke & Lemmen 2000). The authors of the present book define their aims as 'teaching students, laboratory technicians and non-mycologists the fundamentals of mould identification'. However, in my experience in teaching mycology, hands-on experience with living cultures and personal tuition are necessary for learning the skill of identifying fungi. In this context, *Schimmelpilze und deren Bestimmung* might prove useful as a supplementary textbook for practical classes, although its rather high price and limited content of mycological background information may well restrict its distribution and use.

The book starts with a brief introduction to vegetative and reproductive structures, followed by summaries of the main groups of fungi, details of methodology, and keys to the main genera of moulds (mainly fungi belonging to the *Zygomycota* and mitosporic *Ascomycota*). This is the best section of the book, with keys which are clear and workable, and with beautiful black-and-white photographs taken with interference contrast optics. The second half of the book is occupied by listings of the main genera of mould fungi which provide useful literature citations and some information on mycotoxin production and other taxon-specific features. Details of the distribution of individual mould genera are of more limited value since many of them are ubiquitous, and there is consequently much repitition. There is a useful glossary, although the definitions occasionally lack precision; I would not define a zoospore as 'a sexually or asexually produced motile spore (usually flagellate)', or a conidium as an 'asexually formed non-flagellate spore; mitotic spore'. Following the glossary there are chapters on the physiology and ecology of fungi, mycotoxins, and taxonomic concepts. At 3-4 pages each, these last three chapters are simply too brief to have any real value even for the beginner.

There are quite a few typographical errors in the book. Another problem is the numbering of figures; it seems unnecessarily complicated to have to refer, for instance, to Fig.VII.3.1 in a book containing a total of only 28 figures!

The main potential of this book clearly lies in the fact that it is written in German. On most other accounts, I would recommend *Introduction to Food- and Airborne Fungi* (Samson *et al.* 2002), which, at about the same price but with twice the number of pages and twice the page size, covers a similar subject area in much more depth and width.

Mücke, W. & Lemmen, C. (2000) *Schimmelpilze. Vorkommen, Gesundheitsgefahren, Schutzmassnahmen.* Landsberg: Ecomed.

Reiss, J. (1998) *Schimmelpilze. Lebensweise, Nutzen, Schaden, Bekämpfung.* 2nd edn. Berlin: Springer-Verlag.

Samson, R.A., Hoekstra, E.S., Frisvad, J.C. & Filtenborg, O. (eds) (2002) *Introduction to Food- and Airborne Fung.* 6th edn. CBS, Utrecht: Centraalbureau voor Schimmelcultures.

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BASIDIOMYCETES

The Genus *Mycena* in South-Eastern Australia by Cheryl A. Grgurinovic. January 2003. Fungal Diversity Press, Centre for Research in Fungal Diversity, Department of Ecology and Biodiversity, University of Hong Kong, Pokfulham Road, Hong Kong. [Fungal Diversity Research Series No. 9.] Pp. viii + 329, figs 79, col. plates 30. ISBN 962 86765 2 0. Price US $ 80.

This work must have been exciting but daunting to contemplate since the epicentre of field mycology is Europe and the Northern Hemisphere, and tackling any genus in relatively unexplored zones requires considerable dedication. Detached landmasses such as those in Australasia are vital virgin territories to reveal key aspects of the global distribution of species. The study reveals that the area holds a completely different suite of species to those 'familiar' in the Northern Hemisphere, although most fit into sections already described, pointing to an ancient phylogeny. It is an exciting read for those engrossed in the study of '*Mycenacea'*.

Sixty-six species are included, of which 20 species, one variety, and three sections are proposed as new.

The book is neatly arranged in nine chapters, the bulk being in the sixth, which is a taxonomic treatment of the sections included. The first chapter provides a good account of the history of the classification of *Mycena* with a detailed table comparing the interpretations of Kühner, Singer, Smith and Maas Geesteranus. The second chapter is an overview of *Mycena* in Australia with co-author Tom W. May, and represents a considerable amount of work. It reveals a history of 'sending it to Kew' and interpretations *sensu* European species with some realisation of novel species. The authors go through this work with sensible evaluative comments on the historical interpretations. In most cases, no voucher material is available, so descriptions were the only evidence on hand. The authors' interpretations seem appropriate and the conclusions adequately justified. This provides a starting point for the setting out of the main work.

There is a useful short chapter providing a synopsis of the included sections, species, and varieties. This is followed by an overview of descriptions of the genus and its synonyms, and then a key to included sections. The main section follows with detailed descriptions of the species included, headed by a section on materials and methods. Coloured plates are placed at the very front of the book, and good quality drawings accompany the descriptions.

Concerning technique, I was slightly disappointed that the author seems to have missed the significance of the number of lamellae that meet the stipe in *Mycena*. Maas Geesteranus pointed to this significance, and I can confirm it, I have found lamellules and inter-veining to lack significance, but routinely count the lamellae, where that is possible. I mention this feature because it can be used as a field character and also in keys to separate species which superficially look very close. The author, however, does count lamellae per quadrant and this gives some indication of their closeness.

A number of species were only known from the type at the time the author described them, but this applies to many recently described European species too. Parallels with known species include two in section *Lactipedes* which are close to *M. galopus* but with significant differences, such as the almost globose spores and pigmented cheilocystidia in the wonderfully named *M. thunderboltensis*. *M. galopus* is very variable, and several authors have described new species in the Northern Hemisphere which are hardly worthy of varietal status, e.g. *M. leucogala* (Emmett 1992; Chard *et al.* 1983). I collected *M. galopus* deep in a *Nothofagus* forest reserve in New Zealand in 2002, as well as *M. morris-jonesi*; the latter species is very close to *M. neerimensis*.

M. epipterygia is another highly variable species, the only one in sect. *Hygrocyboideae* (*sensu* Maas Geesteranus). It has given rise to a large number of different specific names, but Maas Geesteranus (1989) reduced all of these to varieties. In my experience, the intraspecific variation is so great that only gross morphological differences justify the recognition of novel species. It is so variable in pigmentation, that almost every collection is different in appearance. It is also both lignicolous and humicolous. The author describes four new species in this section, two from single collections.

The new sections described are to accommodate species that are clearly very different to anything yet described. Sect. *Maldeae* accommodates *M. maldea*, which has criniform stipes in some collections. The author defines these as hair like sterile stipes. Such sterile stipes occur in other small *Mycena* species, such as *M. speirea,* and I have regarded this as a developmental defect in primordia, possibly due to some infection. *M. maldea* probably merits separate treatment anyway, with its pileocystidia and two distinct types of cheilocystidia; it does not fit into sect. *Polyadelphia,* and stirps *Metuloidifereae* is raised to section rank here, *M. cystidiosa*, which has lamprocystidial pleurocystidia is in this section. The third new section, sect. *Mulawaestris* is proposed for *M. mulawaestris*, a very glutinous species with stable brown pigment in the cheilocystidia, yet no separable pellicle or separable lamella edge.

Sect. *Galactopoda*, which contains only one species in Europe, is well represented in Australia and New Zealand with three species in each country so far described. There is a good discussion of these six species and of the need to broaden the circumscription of the section. The author makes a similar recommendation for sect. *Fragilipedes* after an extensive review of literature on the section. It is an unwieldy section in my opinion, acting as a sort of holding section for those not fitting elsewhere. In sect. *Cinerellae,* the author's interpretation of Maas Geesteranus' circumscription reveals an error in the latter. She suggests it be amended to encompass species with glutinous stipes. However, one of the most widespread and common species in this section, *M. clavicularis,* has a glutinous stipe except when very dry. Thus, the circumscription should be corrected. It is surprising that sect. *Filipedes* is so poorly represented in south-eastern Australia; the one species *M. austrofilopes* and a variety are unconvincingly separated from *M. filopes*, which is highly variable.

The presumed *Prunulus* species, in *Calodontes*. include lignicolous species which I have also collected in New Zealand. There are two species in section *Roridae*, which will presumably need recombining in *Roridomyces* (Rexer 1994).

This is an excellent and scholarly piece of work and provides a valuable basic reference for Australian *Mycena* species. It should be in all serious mycological libraries.

Chard, J. M., Gray, T. R. G. & Franklin, J. C. (1983) Antigenicity of *Mycena galopus*. *Transactions of the British Mycological Society* **81**: 503-511.

Emmett, E .E. (1992). British *Mycena* species – 1. *The Mycologist* **6**: 72-76.

Maas Geesteranus, R A (1989) Conspectus of the Mycenas of the Northern Hemisphere – II. *Proceedings of the Koninklijke Nederlanse Akademie van Wetenschapen, series C* **92**: 89-108.
Rexer, Karle-Heinz. (1994) *Die Gattung Mycena s.l. Studien zu ihrer Anatomie, Morphologie und Systematik.* PhD thesis, Eberhard-Karls-Universität Tübingen.

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Illustrated Genera of Smut Fungi. By Kálmán Vánky. 2002. 2nd edition. American Phytopathological Society Press, 3340 Pilot Knob Road, St Paul, MN 55121-2097. Pp. ix + 238. ISBN 0 89054 297 X. Price US $ 69.

As noted in the Preface by Terence Ingold, the name of Vánky has come to dominate the contemporary field of smut systematics. Many changes in generic concepts in particular have been introduced since the first edition of this work in 1987, and an update was long overdue. Extensive discussions of ordinal and family systems and the characters used in their definitions (including septal spore types) are followed by a synopsis of the classification used which helpfully encompasses key characters, included genera, and hosts. The key to genera seems clear, but I worry when I see dichotomies based on hosts, for example, 'On monocots (Gramineae)' *versus* 'On dicots', and 'Host plants sterile' *versus* 'Host plants not sterile' (p. 23). However, the main focus of the work is the generic accounts. Each genus has a double-page spread: the left-hand page has places of publication, synonyms, a full description of the genus and of its type species (with information on hosts and distribution), and literature references; and the facing right-hand page is of illustrations of the type species. The illustrations include excellent habit drawings of infected plants, light microscopic and scanning electron micrographs of the spores, and sketches of germinating spores. There is an extensive bibliography and a comprehensive index to accepted names and synonyms – but not to hosts. This will now be the first point of call for all unsure of the genus to which a smut to hand belongs, and a lead into the literature to be consulted for species identification.

Macrohongos de Costa Rica. Costa Rica Mushrooms. Vol. 1. By Milagro Mata. 1999. Instituto Nacional de Bioversidad (INBio), Apdo postal 22-3100, Santo Domingo, Herida, Costa Rica. Pp. 253. ISBN 9968 702 30 7. Price: Not indicated.

Although only titles published since 2000 are generally being included in this column, an exception is made here as there are so few well-illustrated colour field guides to Latin American macromycetes. Further, this book will be of particular utility to visiting mycologists and other naturalists in that the text is presented in double columns, one in Spanish and one in English. Following an introduction to fungi, their importance in ecosystems and industry, and detailed information on how mushrooms particularly are described and should be studied, 90 species (including six ascomycetes) have a double-page spread including a full-colour photograph, description of the fruit body, and information on habitats, seasonality, distribution, uses, etc. Sadly, microscopic characters other than spore-print colour are omitted. A bilingual glossary and bibliography, with many references to pertinent monographs and publications on Costa Rican mushrooms, conclude the work.

I was especially pleased to see that the author had presented a thesis on *Agaricales* and *Russulales* in oak forests in Costa Rica to the Universidad de Costa Rica, and that he had close contacts with several leading North American and European specialists. That guides of such a high standard can be prepared and published in countries such as Costa Rica is encouraging, and augers well for the future of mycology in the region. Now we await not only the further volumes on the macromycetes hinted at in labelling this 'Vol. 1', but also more primary research papers on the country's mycobiota. It is also to be hoped that the book will be used by ecologists studying ecosystem processes in the region and that fungi may come to have a higher profile in such investigations now that at least some of the more conspicuous species can be identified.

Guide des Champignons Comestibles du Bénin. By André de Kesel, Jean T. C. Codjia & N. S. Yorou. 2002. Jardín Botanique National de Belgique, Domaine de Bouchet, B-1860 Meise, Belgium. Pp. 274, col. figs 72. ISBN 99919 95 2 3. Price: Not indicated.

This book, in French, is the result of collaboration between mycologists in Belgium and Benin, and is divided into two main parts. The first is wide-ranging, and covers characters, ecology, distribution, toxic and hallucinogenic species, culture, and ethnomycology – the latter in particular detail and utilizing the series of questions developed by Maria Härkönen initially for use in East Africa. These sections cover almost half of the work. Some 70 species are treated, including over 50 currently eaten in the country. The descriptions are detailed, include original places of publication, microscopic features, local names in seven languages spoken in the country (Bariba, Ditammari, Fulfulde, Nagot, Yoruba, etc), and comments on occurrence and edibility. Colour plates are included. As is often the case in areas little explored by professional mycologists, some species already known to local peoples lack formal names, such as *Amanita crassiconus, Boletus pseudoloosii* and *Hebeloma termitaria* – all introduced here as 'nom. prov.' Other taxa are also not fully resolved taxonomically and appear as, for example '*Chlorophyllum* aff. *molybdites*'. If these is still so much uncertainty about even the top species used in the country, the extent of the research still to be carried out in Benin to properly understand even its macromycetes is clearly enormous. References to the primary scientific literature occur throughout. This is a pioneering work, and with so few general works available on tropical African macromycetes, this is much needed and deserves to be well-used. As in the case of *Macrohongos de Costa Rica* (see above), that two of the authors of this book are from Benin is encouraging and a positive sign for the future strengthening of our understanding of at least the larger fungi in the region. Because of this context, I refrain from a more detailed criticism, but we should not still be seeing 'Bull. ex Fr.' (photo 71) citations (in mitigation ': Fr.' does appear elsewhere for different taxa).

ASCOMYCETES

Sferiaceae Italici. Centuria II. By Giuseppe De Notaris. [Trascrizione commentata della bozza autografa inedita. Edited by Antonio Graniti, Laura Zucconi & Claudio Ciccarone.] 2001. Mycotaxon, P. O. Box 264, Ithaca, NY 14851-0264, USA. [Accademia Nazionale della Science detta dei XL, Scritte e Documenti No. 27.] Pp. 144, CD-ROM. ISBN 0 930845 12 9. Price: Not indicated.

Antonio Graniti prepared an account of De Notaris's (b. 1805, d. 1877) illustrations published in various works back in 1990 (Graniti 1990), and later a reproduction of the first century of De Notaris's classic *Sferiacei Italici* of 1863 in which ascospore characters of numerous pyrenomycetes were documented and illustrated for the first time (Graniti 1995). Sadly, De Notaris was so ahead of his time that the second century of his pioneering work never secured sufficient support amongst his contemporaries to be published in his lifetime. Diagnoses of some new taxa did appear, but not the drawings and data on record cards kept with the drawings were not always identical to what was published. The work was left with a note by De Notaris himself indicating the work was never printed because of a lack of money. This sad situation has now been rectified, with the support of MYCOTAXON Ltd, and the accounts of 107 species destined to feature in *Centuria II* are at last published. In addition to descriptive information, notes of all kinds are included, though not all species were named beyond genus. Conversely, some new taxa in the work are published here for the first time: two new species, two new varieties, and five new combinations. Information on the type species of three genera proposed by De Notaris is included: *Cryptosordaria, Plachosphaeria* and *Mazzantiella.* Annotations by later researchers are also transcribed, most recently amongst these being A. Aptroot and H.-J. Schroers, including a new combination into *Arthopyrenia* by the former (*A. picconii*). W. Gams also helped with the transcription and reviewed the manuscript. A list of the pertinent types still preserved in RO is included, as is a comprehensive bibliography of works cited by De Notaris and annotators. All those concerned with the nomenclature and taxonomy of pyrenomycetes, whether lichenized or not, should make sure they have a copy of his classic, but new, work. The reprint of *Centuria I* is also still available (Graniti 1995), and includes details of material from that already published part still in RO.

Graniti, A. (1990) La figuera e l'opera di Giuseppe De Notaris (1805-1877). [*Memoire di Scienze Fisische e Naturali***109** (1991).] Pallanza: Academia Nazionale delle Scienze detta dei XL.

Graniti, A. (1995) Giuseppe De Notaris Sferiacei Italici. Centuria I. Genova, 1863. *Academia Nazionale delle Scienze detta dei XL, Scitti e Documenti* **15**: i-xxviii, 1-124.

The Powdery Mildews: A comprehensive treatise. Edited by Richard R. Bélanger, William R. Bushnell, Aleid J. Dik & Timothy L. W. Carver. 2002. American Phytopathological Society Press, 3340 Pilot Knob Road, St Paul, MN 55121-2097. Pp. viii + 292. ISBN 0 89054 291 0. Price US $ 85.

Although entitled 'comprehensive', only one chapter concentrates on the taxonomy. This is mentioned here as that is an authoritative overview co-authored by U. Braun, R. T. A. Cook, A. J. Inman and H.-D. Shin (pp. 13-55). Further, the review is well-illustrated by superb line drawings and scanning electron micrographs, detailed discussions of characters used in species separations, a key to the genera, and an extensive bibliography. It is the best synopsis of the group I have seen, and provides an excellent entré for all seeking to identify these fungi. The remainder of the book will of course be an essential reference work for plant pathologists, and has papers at the cutting edge of studies on their epidemiology, genetics, and control.

LICHEN-FORMING FUNGI

Lichen Flora of the Greater Sonoran Desert Region. Vol. 1. Edited by Thomas. H. Nash III, Bruce D. Ryan, Corinna Gries & Frank Bungatz. January 2002. Lichens Unlimited, Department of Plant Biology. Arizona State University, Box 871601, Tempe, AZ 85287-1601, USA. Pp. vii + 532. ISBN 0 9716759 0 2. Price US $ 30.

This first volume of *The Lichen Flora of the Greater Sonoran Desert Region* includes 600 species belonging to *ca* 140 genera, and covers important groups of macrolichens, pyrenocarpous and squamulose lichens, and also the *Lichinales.*

It is pertinent that the study area was delimited taking into account geographical and ecologically affinities rather than following political boundaries, a more natural approach when considering lichen distributions. In the Introduction, the study area is described with respect to the climate, geology, geomorphology, and phytogeography. Two important gradients are present, in altitude from sea-level to 3600 m and precipitation from 70-1000 mm p.a., and extreme temperature amplitude from –9 °C to 50 °C. These result in highly variable habitats and microhabitats able to host a remarkably high diversity of lichen species. Consequently, although restricted geographically, the book is of particular interest to, and can be used in, both nearby and distant regions in which similar habitats are found.

The Introduction is followed by a comprehensive, clear, and profusely illustrated description of lichen thallus morphology and anatomy, vegetative and sexual propagules, and details of the symbionts and tissues formed. This information provides an adequate basis from which to work easily towards the identification of genera and species, and makes the descriptions of taxa in the main body of the work comprehensible even to non-expert or beginner lichenologists. Especially noteworthy is a key to photobionts, with an extensive bibliography and comments. The main bibliography includes around 500 titles. No glossary is provided in this first volume as one is planned for inclusion in the second.

Taxonomic treatments of genera are presented alphabetically. Each has been meticulously prepared by well-known specialists on the corresponding taxa, and as a result in most cases of personal field collection trips through the area. The generic accounts include the family name, type species, number of species worldwide, main bibliographic references, a generic description, geographical distribution, and ecological comments – as well as notes on distinguishing features and a key to the species. For each species, the basionym, synonyms, main references, and sources of illustrations are cited, followed by a description, local and worldwide distributional information, and notes on ecology, substratum, and distinguishing features. Illustrations of particularly interesting or rare species are also provided.

Last but not least, one new genus (*Lobariella*) and 21 new species are described, and eight new combinations made.

The Editors' must be congratulated on the huge amount of work necessary to accomplish this volume, and are to be encouraged to publish the second which will be most welcome.

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Die Flechtenfamilie *Graphidaceae*: Studien in Richtung einer natürlicheren Gliederung. By Bettina Staiger. 2002. J. Cramer in der Gebrüder Borntraeger Verlagsbuchhandlung, D-14129 Berlin. [Bibliotheca Lichenologica No. 85.] Pp. 526, figs 268. ISBN 3 443 58064 5. Price: € 128.

The generic concepts in the graphideoid lichens have traditionally been based on the Saccardo spore groups. This has long been recognized as unsatisfactory, not least because more fundamental differences in exciple structure particularly were available for use. However, most lichenologists have been deterred from addressing the problem because of the shear numbers of taxa involved, encompassing some 78 generic names and around 1000 species.

Bettina Staiger, already known for her careful revision of *Haematomma* (Staiger & Kalb 1995), has risen to the task. Here she addresses the application of all pertinent generic names, and examined around 1000 collections representing 175 species. Nineteen genera are accepted, seventeen formerly described before (but mainly hidden in the synonymy of spore-based genera) and two proposed as new (*Carbacanthographis* and *Platythecium*). A major obstacle to progress in the group had been the number of generic names that were previously untypified; 11 generic names are typified here to resolve this issue. The characters used are mainly based on the structure and location of the excipular and hypothecial tissues, supplemented by iodine reactions of the ascospores, and also ascospore colour (but not so much septation). Many of the names now used will be unfamiliar, and where well-known names are accepted this is with revised circumscriptions. *Graphis, Phaeographis* and *Sarcographa* remain, and *Phaeographina* is kept for the moment just for its type species. *Graphina* becomes a synonym of *Ustalia,* the former name not being proposed for conservation as only a few species formerly placed there remain. I was amused to see that *Phaeographis* still needed to be conserved against several older synonyms, having been involved in proposing this over 20 years ago (Hawksworth & Sherwood 1981)! Four generic names are categorized as 'nomina dubia et rejicienda'; formal rejection, however, requires Committee action under the *Code*, and it could be prudent to make such proposals to preclude all risks of their resurrection.

The system now proposed needs to be tested, and where possible vindicated, by molecular data. The author carried out a little molecular work as a part of this investigation using LSU rDNA which suggested the studies were on the right lines, but as only 11 species were sequenced the results must be treated as preliminary.

The line drawings and photographs are certainly the best yet to have been prepared of these lichens. These, taken with the extended English summary and English versions of the detailed overall key and the keys to species within each genus, will ensure the accessibility of the work to those who do not read German.

The author deserves our congratulations on a job well-done, and after the dust settles over the old concepts and numbers of name changes, the work is sure to be regarded as one of the classic lichen revisions.

Hawksworth, D. L. & Sherwood, M. A. (1981) Proposals for nomina conservanda and rejicienda for ascomycete names (lichenized and non-lichenized). *Taxon* **30**: 338-348.

Staiger, B. & Kalb, K. (1995) *Haematomma*-Studien I. Die Flechtengattung *Haematomma. Bibliotheca Lichenologica* **59**: 1-198.

Lichens of Wisconsin. By John W. Thomson. 2003. Wisconsin State Herbarium, 132 Birge Hall, 430 Lincoln Drive, Madison, WI 53706. Pp. 386, maps 618, figs 2. ISBN 0 9727393 0 0. Price: US $ 22 (plus shipping costs: $ 4 in the USA, $ 8 for Canada and overseas surface mail, and $ 16 for overseas air mail).

John Thomson, now in his ninetieth year, has produced a guide to the lichens of the state where he lives. Keys and descriptions are provided to 615 species in 148 genera, together with maps showing their distribution down to sites within counties. As an experienced author and trainer of lichenologists, not least the late Mason E. Hale jr and the late William L. Culberson, John knows well how to produce a hands-on manual. Further, he actually had a draft field-tested by a group of enthusiastic lichenologists at a Tuckerman workshop in Wisconsin prior to publication. The workshop added 47 extra species to the state list which are listed in an Appendix. The work is spiral bound so the keys always lie flat, and the taxonomy can be viewed as thoughtfully conservative, for example in his acceptance of *Parmotrema* but not of *Rimelia.* While the focus of the work is Wisconsin, as the book covers all lichens in the state, not only the macrolichens and a few conspicuous crusts, it deserves to be widely used in North America. Do order a copy soon if the title is of interest; at such a modest price stocks are likely soon to be exhausted.

Lichenological Contributions in Honour of G. B. Feige. Edited by Manfred Jensen. March 2003. J. Cramer in der Gebrüder Borntraeger Verlagsbuchhandlung, D-14129 Berlin. [Bibliotheca Lichenologica No. 86.] Pp. 491, figs 177. ISBN 3 443 58065 3. Price: € 86.

This contribution, in honour of Benno Feige's 65th birthday, includes 42 articles by 73 friends and colleagues from 19 countries. The papers are wide-ranging, as is appropriate for Benno's interests, and grouped into four sections: Chemicals in lichens (five papers), New species and phylogeny (16), Ecophysiology and morphology (8), and Distribution and ecology (13). While I am sure that Benno will appreciate the warmth of feeling evidenced by this response, the resultant papers have necessarily had to be short.

The papers of systematic interest include ones on a wide range of lichens and lichenicolous fungi: *Biatora, Caloplaca, Caprettia, Cercidospora, Cladonia* (*C. cervicornis* group), *Coccotrema, Cryptothecia, Dermatocarpon, Dimeleana, Diploschistes* (in Australia), *Gyalidea* (*Solorinella* considered a synonym), *Lecidea, Lempholemma, Lepraria, Melanaria, Ocellularia, Peltigera* (*Nostoc'*s), *Phyllopsora, Placopsis, Stromatopogon, Sulcaria, Thamnochrolechia,* and *Varicellaria*. There is also a paper on a variety of cercosporoid hyphomycetes, including several new species.

The scientific and editorial standards are high, and the quality of reproduction of the many half-tone photographs is superb. However, while there is therefore something to interest a wide spectrum of lichenologists, most of the papers are ones which could easily have found places in regular journals. Sadly, to have papers in such volumes causes problems of accessibility as so few universities now subscribe to such series, and the costs are high for individuals. I therefore find the trend towards more and more such volumes a worrying one for the long-term access to the important data they include.

CONIDIAL FUNGI

A Revision of the Species Described in *Phyllosticta*. By Huub A. van der Aa & Simeon Vanev. 2002. Centraalbureau voor Schimmelcultures, P. O. Box 85167, 3508 AG Utrecht, The Netherlands. Pp. i-vi + 510. ISBN 90 70351 47 1. Price ∈ 60.

The title given to this book is inappropriate, because the content does not justify the claim; it is more an annotated list than a revision of names in *Phyllosticta.* Although *Phyllosticta* is the main subject for this book, it is without a modern standard, morphological description and illustration for the genus and its type species. All those familiar with *Phyllosticta* would quickly recognize the two main publications recommended for descriptions and synonymy. The first (van der Aa 1973) forms the nub of Section 7 but contains antiquated details of conidiogenous cells and conidia compared with subsequent observations and advances (Nag Raj 1993, Punithalingham & Woodhams 1982, Yip 1989). The second (Sutton 1980) does not deal especially with *Phyllosticta,* but describes *Leptodothoriella* with phialidic conidiogenous cells, and thereby contradicting the observations of van der Aa (1973) who described blastic conidiogenous cells producing conidia in basipetal succession and illustrated conidia in chains.

The first 49 pages of the book include an abstract, introduction, overview, and key to seven coelomycete genera into which *Phyllosticta* names have been redisposed (*Asteromella, Fusicoccum, Microsphaeropsis, Phoma, Phomopsis, Pleurophoma,* and *Phyllosticta*).

The book has its share of glaring lapses in nomenclature. Despite *Phomopsis* (Sacc.) Bubák being a conserved generic name with *P. lactucae* (Sacc.) Bubák as type species (Riedl *et al.* 1981, Greuter *et al.* 1988, 1994, Uecker 1987), on p. 11 it is stated that 'the genus has not been typified so far'. Again, the homonym *Phyllosticta* Pers. is conserved with *P. convallariae* Pers. as type species (Donk 1964, Greuter *et al.* 2000), but on p. 6 the type of Persoon's name is cited as *P. cruenta.* It also seems that the authors have not kept abreast of other nomenclatural acts: *Guignardia* Viala & Ravaz, a genus with important plant pathogens, is a conserved generic name with *G. bidwellii* as type species (Eriksson & Hawksworth 1986: 132, Greuter *et al.* 2000) – yet on p.6 it is cited as a synonym of *Discochora* Höhnel, the teleomorph of *Phyllosticta.* Another example of a lapse, is the treatment on p. 12 of *Discosphaerina* as bitunicate and a synonym of *Guignardia* (van der Aa 1973) while more recent work considers that genus unitunicate (Holm *et al.* 1999).

In the overview of important genera (p. 9), *Pleurophoma* Höhnel is listed with the type species *P. pleurospora* (Sacc.) Höhnel, but included under that genus with a description is *P. cava* (Schulzer) Boerema *et al.* which for nearly 24 years (i.e. 1973-96) was known as *Phoma cava* (Boerema & Dorenbosch 1973) but has subsequently been renamed as *Pleurophoma cava* (Boerema *et al.* 1996) – although morphologically and anatomically it is not congeneric with the type species of either *Phoma* or *Pleurophoma.*

Sections 5 and 6 (Materials and Methods) contain explanations of entries and abbreviations used, but not of the Methods employed. No suitable microscopic technique is described in van der Aa (1973) as suggested.

The major part of the book, Section 8 (pp. 50-491), is devoted to excluded species with suggestions on positions and redispositions. It is disappointing. The taxonomic treatment is generally erratic, because decisions have been reached in most cases on the basis of the original description and new combinations made without the examination of type or any material (indicated by 'n.s.'). Apparently, in the case of many names, no attempt seems to have been made to locate material. Most taxonomists will appreciate that speculative redispositions are inconsequential and there is no doubt that there will be unpleasant surprises when type or authentic specimens are located and examined.

References and indices conclude the work, but there are no illustrations in the book. The illustrations in van der Aa (1973) are recommended, but those in that publication are mostly inadequate and sketch-like and of little use. The indices are in three parts, but incomplete. Many *Phyllosticta* names with which the authors have grappled in the text but without much success are not found in the indices; to locate those names one has to thumb through the book. The inevitable occasional printing errors can be found, and there is an awful and embarrassing 'howler' based on the generic name for the blue-flowered butterfly pea (p. 151, line 8).

The work is very mundane but ambitious, and a great deal of basic work remains to be done, for example in locating and examining type and authentic herbarium material of numerous names in order to establish their taxonomic status. However, since this book is an attempt to bring all *Phyllosticta* names under one cover, it can be welcomed as an annotated list despite the shortcomings, and used with some caution.

Boerema, G. H. & Dorenbosch, M. M. J. (1973) The *Phoma* and *Ascochyta* species described by Hochapfel in their study on fruit-rotting. *Studies in Mycology* **3**: 1-50.

Boerema, G. H., Loerakker, W. M. & Hamers, M. E. C. (1996) Contribution towards a monograph of *Phoma* (Coelomycetes) – III. *Persoonia* **161**: 141-190.

Donk, M. A. (1964) Nomina conservanda proposita I. Proposals in Fungi Deuteromycetes. *Regnum Vegetabile* **34**: 7-15.

Eriksson, O. E. & Hawksworth, D. L. (1986) Notes on ascomycete systematics. Nos 1-224. *Systema Ascomycetum* **5**: 113-174.

Greuter, W., Burdet, H. M., Chaloner, W. G., Demoulin, V., Grolle, R., Hawksworth, D. L., Nicolson, D. H., Silva, P.C., Stafleu, F. A., Voss, E. G. & McNeill, J. (1988)) International Code of Botanical Nomenclature adopted by the Fourteenth International Botanical Congress, Berlin, July-August 1987. *Regnum Vegetabile* **118**: i-xiv, 1-328.

Greuter, W., Barrie, J. M., Burdet, H. M., Chaloner, W. G., Demoulin, V., Hawksworth, D. L., Jørgensen, P. M., Nicolson, D. H., Silva, P.C., Trehane, P., & McNeill, J. (1994)) International Code of Botanical Nomenclature (Tokyo Code). *Regnum Vegetabile* **131**: i-xviii, 1-389.

Greuter, W., McNeill, J., Barrie, J. M., Burdet, H. M., Demoulin, V., Filgueras, T. S., Nicolson, D. H., Silva, P.C., Trehane, P., Turland, N. J. & Hawksworth, D. L. (2000) International Code of Botanical Nomenclature (Saint Louis Code). *Regnum Vegetabile* **138**: i-xviii, 1-474.

Holm, L., Holm, K. & Barr, M. E. (1999) Once again on *Discosphaerina. Karstenia* **39**: 59-63.

Nag Raj, T. R. (1993) *Coelomycetous Anamorphs with Appendage-bearing Conidia.* Waterloo, Ontaria: Mycologuq Publications.

Punithalingam, E. & Woodhams, J. E. (1982) The conidial appendage in *Phyllosticta* spp. *Nova Hedwigia* **36**: 151-198.

Riedl, H., Wechtl, E. & Sutton, B. C. (1981) Proposal to conserve the name *Phomopsis* (Sacc.)Bubák (1905) against *Myxolibertiella* Höhnel (1903). *Taxon* **30**: 826-828.

Sutton, B. C. (1980) *The Coelomycetes: fungi imperfecti with pycnidia, acervuli and stromata.*Kew: Commonwealth Mycological Institute.

Uecker, F. A. (1987) Typification of *Phomopsis. Mycological Society of<America Newsletter* **38**(1): 54.

van der Aa, H. (1973) Studies in *Phyllosticta* I. *Studies in Mycology* **5**: 1-110.

Yip, H.-Y. (1989) Five new species of *Phyllosticta* on Australian native plants. *Mycological Research* **93**: 489-496.

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Identification of Common *Aspergillus* Species. By Maren A. Klich. 2002. Centraalbureau voor Schimmelcultures, P.O. Box 85167, 3508 AD Utrecht, The Netherlands. Pp. vi + 116. ISBN 90 70351 46 3. Price ∈ 28.

Although this book follows the style of *A Laboratory Guide to Common Aspergillus Species and their Teleomorphs* (Klich & Pitt 1988), it is in fact a completely new and different publication.

Aspergillus is a large economically important genus. Aspergilli occupy a wide variety of habitats, including soil, stored food and feeds. Many are used in the manufacture of fermented foods, as well as sources of enzymes and in chemical production. Conversely, many are deleterious producing harmful mycotoxins, as well as being both human and animal pathogens. The importance of correct identification to species is paramount. The aspergilli have been much studied using molecular techniques. However, there is still a need for a morphologically-based system for identification, and I welcome this book.

The book opens with an introduction to the economic and medical importance of the genus. This is followed by sections on their classification, morphological features, conditions for growth including recipes for various diagnostic media, and a key to identification. The bulk of the book is dedicated to species descriptions.

Species descriptions are on two pages. The left hand page provides the written detail whilst the right provides pictorial details. It is these photographs which make the book. Each species is accompanied by micrographs of colony growth on three different agars, as well as light microscopy of conidia and conidial heads. A useful addition, are SEM's of conidia. Teleomorphic species include SEM's of ascospores. Colony growth is depicted on CYA at 25 ° and 37 °C and MEA. However, xerophilic species such as *Eurotium amstelodami* and *A. penicillioides* are depicted on CYA, MEA and CY20S. If I have any criticisms, it is that the SEM's are at too low magnification, and do not adequately illustrate the beautiful conidial ornamentations to be seen in the aspergilli using this technique.

The written description for each species includes macro- and microscopic features, distinguishing characters and habitats. Where appropriate common synonyms and related species are discussed. A further useful addition, is mycotoxin production, where applicable. An up-to-date bibliography is supplied. Colour prints of seven day old colonies are provided, and a thoughtful addition is the provision of colour prints depicting reverse of plates. This is a useful extra character for some species diagnoses.

The strength of this book lies in the photography. Like all CBS publications, it is printed on good quality paper, and at £19 (∈28) is very good value. I recommend it to all *Aspergillus* taxonomists, as well as MSc and PhD students.

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MYXOMYCETES

Myxomycetes de Extremadura: CampiñaSur. By Gabriel Moreno, Carlos Illana, Aurello Castillo & Juan Ramón García. 2001. Departamento Biología Vegetal, Universidad de Alcalcá, Alcalcá de Henares, Madrid 28871, Spain. Pp. 112, figs 34. ISBN 84 699 5103 3. Price: Not indicated.

Extremadura is one of the poorer and least researched areas of Spain. This work addresses its myxomycetes, and has a checklist of 140 species. The sources of all records in the checklist are provided. There is also a colour-illustrated guide of how to collect and study slime moulds which merits wide use in Spanish-speaking countries. However, the main focus of the book is the accounts of the species. Keys down to genera introduce the species treatments, and then for each species there are not only detailed descriptions but colour photographs to show the habit, and first-rate scanning electron micrographs of capillitia and spores. The only slightly frustrating aspect is the lack of precise localities for many species, which could easily have been indicated by cross-references to the numbers allocated to the 42 main collecting sites; perhaps this was a deliberate strategy to discourage 'twitchers'. This is a 'desideratum' for all myxomycete specialists, and 'compulsory' for those with a particular interest in those of the Iberian Peninsula or the Mediterranean region in general.

FOSSIL FUNGI

Synopsis of Fossil Fungal Spores, Mycelia and Fructifications. By R. M. Kalgutkar & J. Jansonius. 2000. American Association of Stratigraphic Palynologists Foundation, c/o Palynology Laboratory, Texas A & M University, College Station, Texas 77843-4325. [American Association of Stratigraphic Palynologists Contributions Series No. 39.] Pp. 429, plates 36. ISSN 0160-8843. Price US $ 33.

This is a remarkable work from several perspectives. It draws together information on some 950 validly published species names proposed for fossil fungal spores and other elements dispersed through around 300 genera of which only about 70 are extant. This work surely contains more new scientific names than any other to have been published for many years on any group of fungi. There are 12 new genera, one new species, 31 new names, 350 new combinations, and validations for one further genus and 12 species names.

The genera and species are arranged alphabetically, with places of publication and synonyms, followed by the original diagnosis, often extensive authors' comments, notes on the systematic placement, and for species also age, location, and references to illustrations. Line illustrations of the types of all accepted species have been prepared from the original accounts of the species, mainly prepared by a professional illustrator; these are grouped together at the end of the work. While the quality of the illustrations varies, many having being based on photographs, to have so many types of species names illustrated in one place is also remarkable.

Sadly, the authors do not appear to have appreciated that lichen-fungi should logically have been included, as their names strictly refer to the fungal components. As a result, such fascinating and enigmatic structures such as *Thuchomyces* and *Winfrenatia* (Taylor *et al.* 1997) are not covered. In addition, work relating to the interpretation of *Pelicothallos* as a foliicolous lichen, probably *Strigula,* has been missed (Sherwood 1985).

While the target audience for the work is those active in palaeomycology, for whom it is sure to be the 'bible', this is not something to be passed over quickly by other mycologists. It is also important for the detailed review of the fossil fungal record and the account of the history of palaeomycology (pp. 3-10) which will be of interest to all who teach the origins of fungal groups. Specialists on different groups of fungi will also enjoy turning over the plates and perhaps finding spores representative of groups they never knew had a fossil record. Further, all those interested in fungal phylogenetics and the dates or origins of different groups should consult this as a potential source of independent data for checking molecular clock date estimates.

Two final remarkable aspects of this work are that it is presented in a loose-leaf ring binder (with pockets for notes inside both covers), and the cost. At a mere US $ 33 there is little excuse for general mycological libraries not having this major reference work on their shelves.

Sherwood, M. A. (1985) *Pelicothallos* Dilcher, an overlooked fossil lichen. *Lichenologist* **17**: 114-115.
Taylor, T. N., Hass, H. & Kerp, H. (1997) A cyanolichen from the Lower Devovian Rhynie chert. *American Journal of Botany* **84**: 992-1004.

MISCELLANEOUS

The Names of Plants. By David Gledhill. 2002. 3rd edn. Cambridge University Press, The Edinburgh Building, Shaftesbury Road, Cambridge CB2 2RU, UK. [Also 40 West 20th Street, New York, NY 10011-4211, USA.] Pp. ix + 326. ISBN 0 521 81863 X (hardback), 0 521 52340 0 (paperback). Price US $ 70 (hardback), 25 (paperback).

This work first appeared in 1985 and was originally entitled *The Naming of Plants and the Meanings of Plant Names.* That concept is retained. While the bulk of the work is a glossary on the meaning of vascular plant names which may be of some value to those searching for possible epithets for novel fungi, the first 57 pages cover a variety of topics not generally easily accessible in readily available works. The challenge of naming organisms, its size, how the problem was addressed, and an introduction to the *Code* (and that for cultivated plants). While not dealing with fungi *per se,* the in-depth discussion of the origins and utility of the binomial system are pertinent, as is the introduction to the rules of nomenclature. This is work perhaps worth noting to refer inquisitive students to, rather than recommending only more erudite (and off-putting) works. If you chance upon a copy in a bookshop or on a botanist colleague's shelf, browse through the introductory chapters and come to your own conclusions.

NOMENCLATURAL NOVELTIES PROPOSED IN MYCOTAXON VOLUME 86

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Agrocybe munnarensis K. A. Thomas & Manim., p. 322
Agrocybe wayanadensis K. A. Thomas & Manim., p. 326
Caloplaca coeruleofrigida Søchting & Seppelt, p. 163
Canomaculina ultralucens (Krog) Elix & J.B. Chen, p. 21
Ceriporia lacerata N. Maek., Suhara & R. Kondo, p. 342
Entoloma alliodorum Esteve-Rav., E. Horak & A. Ortega, p. 228
Entoloma graveolens (Largent) Esteve-Rav. & A. Ortega, p. 231
Entoloma vineaceocontusum (T. J. Baroni) Esteve-Rav. & A. Ortega, p. 231
Glomus spinuliferum Sieverd. & Oehl, p. 158
Gymnopus fibrosipes (Berk. & M. A. Curtis) J. L. Mata, p. 313
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Gymnopus lodgeae (Singer) J. L. Mata, p.313
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Erratum

Vol. 82, April-June 2002

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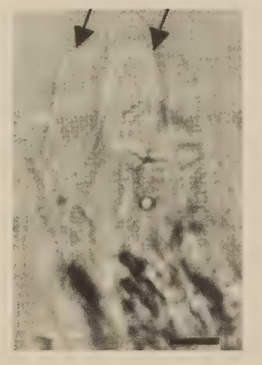

Erratum

Vol. 82, April-June 2002

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†***Cortinarius trivialis*** J.E. Lange
Easily recognizable, but very rare species in the investigated forest, collected once at the end of October 1998. Reported previously only from *Quercus* forests (Diamandis & Perlerou 1990, Diamandis 1992, Constantinidis 1994).

Crepidotus mollis (Schaeff.) P. Kumm.
Common on deciduous trees, but this was the first record on *Fagus* wood for Greece (Zervakis et al. 1998).

Crepidotus sphaerosporus (Pat.) J.E. Lange
Collected in October 1999 (S1). Only one previous record, on *Fagus* wood as well (Maire & Politis 1940).

****Crustomyces subabruptus*** (Bourdot & Galzin) Jülich
Collected together with *Dentipellis fragilis* from the same trunk in October 1999 (S2). This species (which is reported as mainly occurring on wood of conifers) is characterized by the densely odontioid hymenium, the dimitic hyphal system (skeletal hyphae in the subiculum), the ellipsoid spores and the presence of gloeocystidia. Dendrohyphidia could not be detected [according to Eriksson & Ryvarden (1975), they are absent in some specimens]. Our collection agrees with the description of Eriksson & Ryvarden (1975), whereas in the description of Breitenbach & Kränzlin (1986) the spores are somewhat oblong. First record of the genus for Greece.

****Dentipellis fragilis*** (Pers.) Donk
Resupinate fungus bearing on the hymenial layer crowded fragile spines up to 10 mm long. The hyphal system is monomitic, it has clamped hyphae, hymenium with long fusiform gloeocystidia and amyloid smooth to slightly punctate spores. Common in N. Europe but rare in Greece. Collected in October 1999 from a rotten trunk lying on the ground (S2).

****Endoptychum agaricoides*** Czern.
Recorded in large numbers during the entire autumn period of 1999, on soil rich in sheep manure, around two sheepfolds at the forest edge at 1,400 m (S1) (a site forayed more than 10 consecutive years) and in the alpine zone at 1,600 m (recorded again at this site in October 2000). Although Singer & Smith (1958) considered the lack of hyphal clamps and of germ pores as common-distinct characteristics of the four *Endoptychum* species, we observed (Dimou & Zervakis 2001) the presence of very scarce clamp connections on the pileipellis hyphae (more frequent on the hyphae in pure cultures) as well as the presence of germ pores (also reported by Conard 1915). These observations seem to raise again the question about the generic position of this taxon (in *Secotium* or *Endoptychum*), although this is the type species of the genus (Czerniaiev 1845). It is worthy to notice that two of the species included in *Endoptychum* [*E. agaricoides* and *E. arizonicum* (Shear & Griffiths) A.H. Sm. & Singer] produce hyaline to light-colored spores, while the other two [*E. depressum* A.H. Sm. & Singer and *E. melanosporum* (Berk.) Singer & A.H. Sm.] produce dark-colored ones. Singer & Smith (1958) had the opinion to maintain them all in the genus *Endoptychum*, in two separate sections, based on the same habitus and on the fact that *E. agaricoides* is the type species. This is the first secotioid species recorded in Greece.

†***Entoloma hirtipes*** (Schum.) M.M. Moser
Common, collected in the autumn (October 1998) as well as in the spring just after the snow melting (April 1999) (S1).

Entoloma sinuatum (Bull.) P. Kumm.
Rare species, recorded once during October 1995 (Zervakis et al. 1998). Reported exclusively from *Fagus* forests in Greece.

Fomes fomentarius (L.) J. Kickx f.
Very common on living and dead trees (Zervakis et al. 1998).

Erratum

Vol. 84, October-December 2002

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Gymnopilus spectabilis* var. *pampeanus (Speg.) Singer
Figs. 4 –7, 13 – 33, 45 – 47

Macromorphological characters: 30% of plate cover by the 10th day (2.55 cm) (strain 444/01) and 40% of plate cover by the 10th day (3.4 cm) (strain 47/99); mat downy, homogeneous, white; advancing zone superficial; margin uneven; reverse unchanged.
Oxidase reactions: gallic acid +, gum guaiac +, tannic acid -.

Micromorphological characters strain 444/01. Aerial mycelium: hyphae 1.2 – 4 µm diam., thin-walled, branched, septate, with clamp connections, some inflated, hooked, multiple or irregular clamps, with short branches similar to incomplete clamps, hyaline, with or without granulose refringent content; arthrospores absent; chlamydospores absent; capitate apices (2.4 – 4.8 µm diam.) from narrow tapering hyphae (8 – 20 µm long), abundant. Advancing zone: hyphae with abundant short branches straight or bent similar to incomplete clamps; arthrospores, chlamydospores and capitate apices absent.
Micromorphological characters strain 47/99. Aerial mycelium: hyphae 0.8 – 3.2 µm, thin-walled, branched, septate, with clamp connections, some with multiple, septae rarely simple without clamps, few transversal anastomoses, with protuberances or very short branches, hyaline, with or without granulose refringent content; arthrospores 6.4 – 10.6 X 2 – 2.4 µm, cylindric, hyaline, with refringent content, uncommon; developing chlamydospores 7.2 – 10 X 6.4 – 8.8 µm, ellipsoid to globose, wall thin to subthick, hyaline, with or without granulose content, many terminal, few intercalar. Advancing zone: flexuose hyphae abundant, with many short branches; arthrospores and chlamydospores absent.
Species code strain 444/01: 1.2.3.7.36.38.54
Species code strain 47/99: 1.2.3.7.34.35.36.38.54
Material studied: strain INTECH 444/01, isolated by S. Sede from fruitbody on *Eucalyptus* sp. (Argentine, Buenos Aires, Capital Federal, El Rosedal, May 10, 1994, *S. Sede s.n.*, BAFC-2200). Strain INTECH 47/99, isolated by F. Pieckenstain from fruitbody below *Eucalyptus* sp. (Argentine, Buenos Aires, Chascomús, INTECH Campus, March 25, 1999, *C. Pereyra s.n.*).
Note: The strain 444/01 was the same described by Sede & López (1999). We did not observe chlamydospores in this strain but they did. They found a positive result with tannic acid and a negative with guaiacol.

Gymnopilus subearlei R. Valenz., Guzmán & J. Castillo
Figs. 34 – 44, 48 – 51

Macromorphological characters: 70% of plate cover by the 10th day (5.9 cm); mat downy to cottony, homogeneous, white; advancing zone superficial; reverse unchanged.
Oxidase reactions: gallic acid +, gum guaiac -, tannic acid -.
Micromorphological characters. Aerial mycelium: hyphae 0.8 – 4 µm diam., thin-walled, branched, septate, with clamp connections, some clamps inflated, with few anastomoses, hyaline, with or without granulose refringent content; arthrospores 4.4 –

Erratum

Vol. 85, January-March 2003

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ERRATA

VOLUME EIGHTY-TWO

Page 201, line 43	for	*H. subbrevipes*	read	*Melanoleuca subbrevipes*

VOLUME EIGHTY-FIVE

Cover 1, Contents, line 2	for	*thermophilous*	read	*thermophilic*
Page iii, line 3	for	*therophilous*	read	*thermophilic*
Pages 131, 143, 147, 159, 175, 241, 247, 271, 277, 297, 319, 331, 345, 423, line 2	for	*Volume LXXX*	read	*Volume LXXXV*
Page 524, line 6	for	*R, Berndt*	read	*R. Berndt*

VOLUME EIGHTY-SIX

Cover 2, line 38	for	**Urja**	read	**Irja**
Page *iv,* line 40	for	**Urja**	read	**Irja**
Page 5, last line	for	*melanigenum*	read	*melanogenum*
Page 9, line 8	for	*melanigenum*	read	*melanogenum*
Page 12, line 9	for	*melanigenum*	read	*melanogenum*
Page 124, line 24	for	*gelatinousm*	read	*gelatinosum*
Page 127, line 26	for	*bloxami*	read	*bloxamii*
Page 143, line 3	for	*Russula rubioalba*	read	*Russula rubroalba*
Page 145, line 13	for	*latitabundulus*	read	*latitabundus*
Page 145, line 42	for	*bloxami*	read	*bloxamii*
Page 227, line 15	for	*vinaceocontusus*	read	*vinaceocontusum*
Page 363, lines 16-17	for	*coorgian*	read	*coorgiana*
Page 369, line 35	for	*pseudosinosa*	read	*pseudosinuos*
Page 370, line 20	for	*Lichen sinuosa*	read	*Lichen sinuosus*
Page 426, line 11	for	*arucaricola*	read	*araucariicola*
Page 446, line 24	for	*messneri*	read	*meissneri*
Page 460, line 3	for	*amiantina*	read	*amianthina*
Page 497, line 12	for	**Urja**	read	**Irja**

MYCOTAXON

Volume LXXXVI, pp. 529-530 April-June 2003

EDITORIAL CHANGES COMING FOR MYCOTAXON

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We are pleased to announce changes that we firmly believe will improve the journal and simultaneously allow us to retire gracefully from the editorial duties that have become too arduous for both of us. Effective with the close of volume 88 (the October-December 2003 volume) we shall both step down: Pavel from his position as Editor-in-Chief, and Dick from his position as Assistant Editor. Pavel will assume a new position, Consulting Editor, to work with the new Editor-in-Chief in making the transfer seamless. Dick will continue as Business Manager for Mycotaxon, Ltd., having already shed his duties as the corporate webmaster. We each have other responsibilities.

Dr. Lorelei Norvell, of Portland, Oregon, will be the new Editor-in-Chief, effective with volume 89. She is well known to most taxonomist-readers. Not only can she rely on Pavel and Dick to make the transition, but she will have the full support of an active Editorial Advisory Board of eminent mycological taxonomists and nomenclaturalists. That Board has recently been engaged in a lively discussion amongst themselves and with the current Editors on ways to allow *Mycotaxon* to refocus on its original goal, to serve as a journal "devoted to the taxonomy and nomenclature of fungi and lichens." Strict interpretation of those two disciplines has been suggested, and Lorelei will oversee their implementation. We will begin the process of limiting the scope of the journal with volume 89. Here are the two areas subject to changes:

1) Does a checklist constitute "taxonomy"? Good checklists are very helpful in taxonomic work, but only if they are based on cited or referenced specimens, do not cover only a very small locality, and reflect many years of collections. Nomenclatural novelties should not be proposed in a checklist, but rather included in a separate, "taxonomic" paper. Checklists, the Board has concluded, should be seen as in need of constant updates, and thus should be posted on the worldwide web—rather than in a regional or international journal. Such checklists are far more easily searched on the internet than in printed copy, and electronic versions can be easily and regularly updated as data accumulates. A one or two page paper announcing the posting of such a floristic data set and of its focus and extent would, however, be welcomed in *Mycotaxon.*

2) When do studies in phylogenetic systematics constitute "taxonomy and nomenclature"? Much depends on how one uses the terms "taxonomy" and "systematics." Most members of the Board and the Editors consider taxonomy a part of systematics, but understand that phylogenetic systematics is not necessarily taxonomy. A paper proposing a new interpretation of phylogeny without in turn requiring or suggesting specific nomenclatural novelties would appear *not* to be taxonomic in our strict interpretation of

"taxonomy." Such purely "phylogenetic" (or, on the same grounds, purely "ecological") papers should probably be submitted to another journal. Pavel and Dick, trained as alpha taxonomists, would be the first to admit that we lack the credentials to assess whether authors are sufficiently rigorous in basing a paper on cladistic or molecular analyses. It was never our desire to publish papers that would have been rejected by other journals using high standards in these areas. The difficult job of drawing the distinction for *Mycotaxon* as it evolves will be at the sole discretion of the new Editor-in-Chief.

It is with a sense of pride that we leave these problems in more able hands than ours. We have great faith in Dr. Norvell's abilities to work with authors and to improve the journal.

Authors should keep a wary eye on our website, **<www.mycotaxon.com>**, for the most recent information on submission of manuscripts during the next several months. Volumes 87 and 88 are still under Dr. Lizon's direction, and if any of you have checklists or phylogenetic studies you'd like to see appear in *Mycotaxon,* you still have time to submit them for publication. The new Editor-in-Chief will give sympathetic consideration to papers in a series already partially published in our journal.

Given the proposed revision of editorial policies, and the change in editorship, Dick, in his role as Business Manager, has determined that *Mycotaxon* will publish only two volumes in 2004, volumes 89 and 90, each consisting of two quarterly numbers. Depending on the flow of acceptable papers, our new Editor-in-Chief may choose to expand to three or four volumes a year in future years.

Reviewers, Volume Eighty-Six

The Editors express their appreciation to the following individuals who have, prior to acceptance for publication, reviewed one or more of the papers appearing in this volume.

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Fungi of China, by S. C. Teng. Mycotaxon, Ltd. 1996. Hardbound, xiv + 586 pp., 426 illustrations, map, portrait, index, 8–1/2x11 inches. $79.00. Airmail price varies by country: enquire. ISBN 0-930845-05-6.

Special for *Mycotaxon* subscribers: deduct $20 from regular price

Edited by Richard P. Korf, with a foreword by Teng's daughter, Rosaline Z. Deng. Proceeds from sales go to the Teng family.

What reviewers have to say about Teng's Fungi of China

"... one of the most valuable books on the fungi of China ever published in English." *Mycologia* 90: 1091-1092, 1998.

"... a great big blue uncompromising brick of a book ... an instant classic. Anyone interested in identification of fungi, particularly in Asia, should get this book immediately. Mycology owes another debt to Dick Korf for his sympathetic and intelligent editing of this superb work." *Bibliography of Systematic Mycology* 10(6): xlviii-xlix. 1998.

"The book is important for any researcher interested in the systematic relationships, diversity, and distribution of fungi on a global scale." - *New Zealand Journal of Botany* 35: 265-266. 1977.

Higher Fungi of Tropical China, edited by Wen-Ying Zhuang. Mycotaxon, Ltd. 2001. Cloth bound, 485 pp., 26 x 18.5 cm. US$50.00 plus postage. (Please ***order direct*** from Wen-Ying Zhuang, P.O. Box 2714, Beijing 100080, China, email zhuangwy@sun.im.ac.cn). ISBN 0-930845-13-7.

Some 5056 named species belonging to 1192 genera of higher fungi hitherto known from tropical China are listed. Useful references, detailed tropical distribution, and hosts or substrates are provided for each species. Contributing authors: Lin Gou, Shou-Yu Guo, Ying-Lan Guo, Xiao-Lan Mao, Shu-Xiao Sun, Shu-Xia Wei, Hua-An Wen, Zhi-He Yu, Xiao-Qing Zhang, Jian-Yun Zhuang, and Wen-Ying Zhuang.

Spheriacei Italici. Centuria II, by Giuseppe De Notaris. *Annotated transcription of the unpublished autographic draft,* edited by Antonio Graniti, Laura Zucconi, & Claudio Ciccarone. Mycotaxon, Ltd. 2001. Softbound, 144 pp., illustrated [includes CD showing reproductions of the original manuscript and drawings in JPG-format], 23.5 x 16.5 cm. 65 Euro, plus postage. (Please ***order direct*** from Accademia Nazionale della Scienze detta dei XL, Via Spallanzani 7, I-00161 Roma, Italy, email: biblioteca@accademiaxl.it, fax +39.06.44250871.) ISBN 0-930845-12-9.

Includes 104 fungal species, whose names are brought up to date. Most of the original specimens were traced and many types were identified, some of which were examined microscopically.

Mycotaxon Cumulative Index for Volumes XLI-LX (1991-1996), by Karen D. Gettelman, Richard P. Korf, Susan C. Gruff, and Ian F. Korf. Mycotaxon, Ltd. 1998. Softbound, 296 pp., 6x9 inches. $35.00. Airmail, $55.00. ISBN 0-930845-07-2.

Mycotaxon Cumulative Index for Volumes XXI-XL (1984-1991), by Richard P. Korf and Susan C. Gruff. Mycotaxon, Ltd. 1991. Softbound, 352 pp., 6x9 inches. $30.00. Airmail, $50.00. ISBN 0-930845-01-3.

Mycotaxon Cumulative Index for Volumes I-XX (1974-1984), by Richard P. Korf and Susan C. Gruff. Mycotaxon, Ltd. 1984. Softbound, 232 pp., 6x9 inches. $17.50. Airmail, $37.50. ISBN 0-930845-00-5.

A Monograph of the Fungus Genus Cercospora, by Charles Chupp. Published by the author, Ithaca. 1953. Hardbound, 667 pp. 222 illustrations, octavo, $25.00. Airmail, $45.00 Proceeds from sales go to the Chupp family.

Still a classic after a half century.

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TAXONOMY & NOMENCLATURE OF FUNGI, INCLUDING LICHENS

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VALIDATION OF TERRIERA SAMUELSII

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Terriera samuelsii, proposed as a new species in JOHNSTON (2001), was invalidly published after the paragraph citing the type specimen was inadvertently deleted during final preparation of the camera-ready copy. The protologue as published in JOHNSTON (2001) is given here in full, along with the missing typification statement. The species should be cited as *Terriera samuelsii* P.R. Johnst., *Mycotaxon* **86**: 1, 2003.

Terriera samuelsii P.R. Johnst., **sp. nov.**

Etymology: In honour of the collector of the type specimen, Gary Samuels.

A *T. arundinacea* pariete ascomatis atro, lineis atris stromaticis maculas pallidas cingentibus, conidiomatibus dilute brunneis deinde denigricantibus differt.

Infected areas on dead leaves, paler than surrounding host tissue, associated with incomplete, narrow, dark zone lines, containing ascomata and conidiomata. *Ascomata* 0·7–3 × 0·3 mm, oblong to sublinear in outline, ends rounded, wall black, with indistinct paler zone along future line of opening, single longitudinal slit with black, shelf-like area lining either side. *Ascomatal structure* typical of *Terriera* (see Johnston 2001, p. 37–39). *Paraphyses* 1·5–2 µm diam., undifferentiated to slightly swollen at apex, unbranched, embedded in hyaline to yellowish gel with numerous crystalline inclusions, extending 10–20 µm beyond asci as epithecium. *Asci* 125–140 × 7–8 µm, cylindrical, broadly rounded at apex with undifferentiated wall, 8-spored, well-developed basal stalk at maturity with spores confined to upper 80–100 µm. *Ascospores* (65–) 75–90 × 2 µm, ± straight when released, tapering slightly to ends, 1-septate, with no gelatinous sheath. *Conidiomata* 0·2–0·3 mm diam., round in outline, wall initially pale brown, becoming black. *Conidiogenous cells* 7·5–10 × 3–5 µm, solitary, ± cylindrical, proliferation sympodial, often with two conidia held at apex. *Conidia* 4·5–6 × 1·5 µm, short-cylindrical, straight, ends rounded, non-septate, hyaline.

Typification: Brazil: AMAZONAS: Araca Summit, cloud forest, W facing palisade, on monocotyledon, 13 Feb. 1984, *G.J. Samuels* 260 (**NY!,** *holotypus*; **PDD**! 58074, *isotypus*).

Host: Unidentified monocotyledon.

Distribution: Brazil, Guyana.

Illustration: Fig. 1 (= Fig. 103 in JOHNSTON, 2001).

Notes: *Terriera samuelsii* is similar to the Asian *T. arundinacea* in ascus and ascospore size, and shape of the ascus apex and paraphyses. The latter species differs in having paler ascomata, lacking conidiomata and not being associated with zone lines.

Although the host remains unidentified, it appears to be the same in all collections examined.

Additional specimens examined: Brazil: AMAZONAS: Serra Araca Plateau, 14–16 Feb. 1984, *G.J. Samuels* 278 (**NY**; **PDD** 58073); Serra Araca summit, Gallery Forest, 12 Feb. 1984, *G.J. Samuels* 224 (**NY**; **PDD** 58072). **Guyana:** POTARO-SIPARUNI: Potaro: Mt Ayanganna, eastern side, on grass, 11–12 Mar. 1987, *G.J. Samuels* 5113 (**NY**).

REFERENCE

JOHNSTON, P.R. 2001: Monograph of the monocotyledon-inhabiting species of *Lophodermium*. *Mycological Papers* **176**: 1–239.

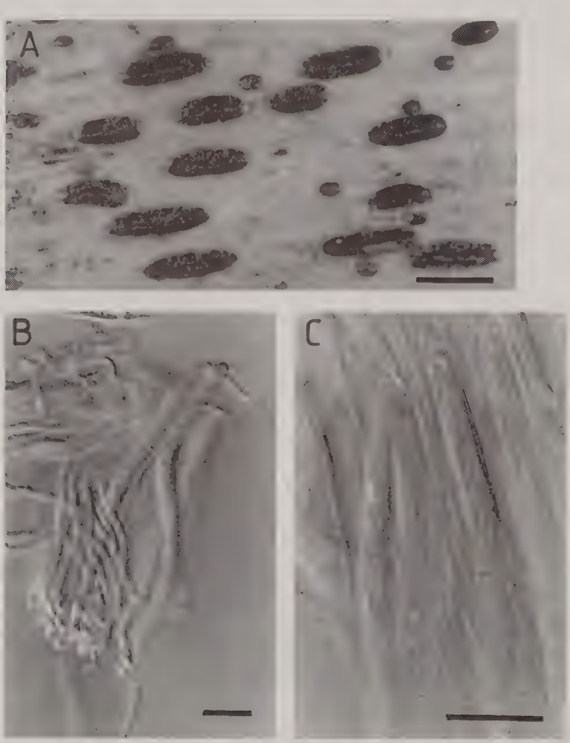

Fig. 1. *Terriera samuelsii* (**PDD** 58074). **A**, ascomata (bar = 1 mm); **B**, asci; **C**, apex of asci and paraphyses (bars = 20 μm).

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CALICIOID LICHENS AND FUNGI DESCRIBED BY J. NÁDVORNÍK

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Abstract: A revision of 53 taxon names of calicioid lichens and fungi described by J. Nádvorník and 3 taxon names by M. Servít & J. Nádvorník is presented. For the following taxa lectotypes have been designated: *Calicium adspersum f. nuda, Calicium consociatum, Calicium cretzoiui, Calicium quercinum f. nuda, Calicium quercinum f. subcrustosa, Calicium salicinum var. arenarium, Calicium viridireagens, Chaenotheca dilatata, Chaenothecopsis gracilis, Coniocybe farinacea f. minima, Cyphelium brachysporum, Cyphelium inquinans f. ecrustacea, Mycocalicium rappii.* One new combination, *Chaenothecopsis rappii,* is proposed.

Key words: *Calicium, Chaenotheca, Chaenothecopsis, Coniocybe, Cyphelium, Mycocalicium,* lectotypes, Nádvorník, *Chaenothecopsis rappii* comb. nov.

Introduction

Dr. Josef Nádvorník was a prominent Central European lichenologist of the 20th century. He was born on the 13th of February 1906 in Pláňavy near Hlinsko (Czech Republic). When working as a teacher in Uzhgorod (now Ukraine) and later in Prague, Nádvorník started to study lichens intensely, although he had to carry out all his scientific work in his spare time and without financial support. He started lichen floristic investigations in the Jizerské hory Mountains, later in the Belianske Tatry and Vysoké Tatry Mountains and in many other parts of the former Czechoslovakia. He also dedicated himself to other areas of lichenology: systematics, ascoma ontogeny and the history of the lichenology. His interest in taxonomy was further stimulated by his teacher and later collaborator Dr. Miroslav Servít (Černohorský, 1978). Nádvorník first started detailed and critical studies of calicioid lichens and fungi, then of the Physciaceae, Lecideaceae and the genus *Usnea*. In his taxonomic works he described several new genera, sections, species and infraspecific taxa (Grummann, 1974).

Nádvorník's herbarium comprises more then 11 000 specimens. From 1962, due to the effort of Dr. I. Pišút, the herbarium of Nádvorník was moved to the Slovak Natural History Museum (BRA). Some duplicate specimens were deposited in W and M. Nádvorník issued an exsiccata 'Caliciaceae exsiccatae', which was distributed to major herbaria in other countries. Nádvorník died in Prague, on the 8th of July in 1977.
Nádvorník´s collections in M, W and also partly in BRA (*Chaenotheca*) were investigated by Tibell, the herbarium in BRA by Titov and Lisická.

Nádvorník's contribution to the classification of calicioid lichens and fungi

After having published some general floristic works on lichens (Nádvorník, 1932a, 1932b, Servít & Nádvorník, 1932) Nádvorník became interested in the taxonomy of calicioid lichens and fungi. In his first papers (Nádvorník, 1934, 1936, 1938, Servít & Nádvorník, 1932, 1936) he described new taxa (species and infraspecific taxa) from Czechoslovakia. He soon expanded his interest to Romania (Nádvorník, 1937) and published brief reviews of the calicioid lichens of Central Europe (Nádvorník, 1940a, 1940b, 1942a). These included descriptions of several species and infraspecific taxa. Based on further studies of material in herbaria he also published a review of Caliciaceae (Nádvorník, 1942c) and an important paper on extra-European calicioid lichens (Nádvorník, 1942b).

In all, Nádvorník described 5 new genera (*Allophoron*, *Pyrgillocarpon*, *Sphinctrinella*, *Stephanophoron* and *Texosporium*), 24 new species and 34 infraspecific taxa of calicioid lichens and fungi. He also described 12 new sections in *Calicium*, *Chaenotheca*, *Coniocybe* and *Cyphelium*. Nádvorník's infrageneric classification of *Chaenotheca* was discussed by Tibell (2001). *Pyrgillocarpon*, *Stephanophoron* and *Texosporium* were not validly published by Nádvorník but were later validated by Tibell & Hofsten (1968; *Texosporium*) and Tibell (1984; *Pyrgillocarpon* and *Stephanophoron* renamed *Nadvornikia*).

In his first works, Nádvorník adopted Vainio's ideas on the classification of 'Coniocarpeae' (Vainio, 1927). Vainio's classification was based on nutritional biology of the species along with morphological characteristics of the thallus and ascomata. In his later treatments, Nádvorník excluded from the Caliciaceae the non-lichenized genera recognized by Vainio, but his interest also in these genera was shown by publications on European species of *Mycocalicium*, *Embolidium* (Nádvorník, 1940b) and *Stenocybe* (Nádvorník, 1941a).

Nádvorník stressed the importance of ascoma anatomy for the delimitation of taxa. He also first described an unusual type of ascus ontogeny during which the asci are formed without croziers (Nádvorník, 1941b).

Nádvorník described many infraspecific taxa in a manner typical of the time. These were usually described as formae, and the descriptions were based on one or a few specimens only in a rather typological manner. With a better understanding of the variation of morphological features in populations, recognition of infraspecific taxa of this kind was largely abandoned in lichenology during the latter part of the 20th century. As we see it, the vast majority of these infraspecific taxa merely represent phenotypic variation that is continuous if a wider material is studied, and given the requirement that also infraspecific taxa should be monophyletic (Heidmarsson et al., 1997) we find no argument for such taxa to have been found. On occasion, however, what has later been understood as well-characterized species were named as infraspecific taxa of other species. For example, Nádvorník recognized *Chaenotheca subroscida* as a variety of *Ch. phaeocephala*, var. *subhispidula*. In other cases unwarranted names were given by Nádvorník to species that already had been described. This is understandable since Nádvorník often did not have the possibility to study material of earlier described taxa and typifications of old material were often unclear or wanting. Thus, for example, he described as *Chaenotheca suzai* a species described already by Acharius, viz. *Ch.*

chlorella. This has left quite a legacy of names of taxa that need clarification, and to do this for the names created by Nádvorník is the aim of this study.

List of names of calicioid taxa published by Nádvorník

albomarginata

Coniocybe farinacea f. *albomarginata* Nádv. 1934: 310.
'Deutschland: Alte Ulme der Donau-Au seitlich von Düngeleu bei Ingolstadt (Typus in hb. München).'

Type: Germany, 'alte Ulme der Donau-Auen seitlich von Düngeleu bei Ingolstadt 5/67' (M: specimen annotated with label: '*Coniocybe farinacea* f. *albomarginata* f. n. X. 1933 Josef Nádvorník. Typus', holotype).

Nádvorník characterized f. *albomarginata* by its white-brimmed ascomata. **The holotype represents *Sclerophora farinacea* (Chevall.) Chevall**. and the white brim of the ascomata may be just an occasional artifact (see also 'gracilis' – 1).

alpina

Chaenotheca phaeocephala f. *alpina* Nádv. 1942a: 19.
'Düne Ziabenäste auf dem Schlachen bei Partenkirchen, 1874 leg. Arn. (*"Cyphel. trichialis"*, Herb. Arn.).'

Type: Germany, 'Düne Ziabenäste (sic!) auf dem Schlachen bei Partenkirchen, Bayer. Alpen, 1874, Arnold' (BRA, lectotype designated by Tibell, 1980: 42, citing corrected label data).

Nádvorník characterized f. *alpina* as having a thallus consisting of smooth, convex, brownish and scattered verrucae. Such thalli are also formed in other species of *Chaenotheca* when growing in exposed and high altitude situations, but there seems to be a continuous variation in these features depending on the habitat. **The lectotype represents *Chaenotheca phaeocephala* (Turner) Th. Fr.** (Tibell, 1980).

Chaenotheca phaeocephala occurs on wood and bark of both coniferous and deciduous trees, most commonly on bark of *Quercus* spp., and on wooden walls and fences. *Ch. phaeocephala* is widely distributed in cool to temperate areas of the Northern Hemisphere (Eurasia, North America).

arenarium

Calicium salicinum var. *arenarium* Nádv. 1936: 54.
'Podkarpatská Rus: Nižní Verečky: na pískovcových balvanech vrchu Vysoký Kámen u osady Podplazí, 500 m.'

Type: 'Rossia Subcarpathica: Nižní Verečky: in monte Vysoký kámen pr. pag. Podplazí, 500 m, 1.9.1935 leg. et det. Nádv.' (BRA, lectotype designated here.)

The lectotype represents *Calicium salicinum* Pers. In the same collection there is also some material of *C. corynellum* Ach. The protologue, however, clearly refers to *C. salicinum*, for example describing var. *arenarium* as having a greenish glaucous to grey thallus and a K+ red reaction of the capitula.

Calicium salicinum occurs on bark and wood of both deciduous and coniferous trees, and is widely distributed in both hemispheres. Only rarely, however, it occurs on rocks.

athallina
Calicium schaereri f. *athallina* Nádv. 1942a: 9.
'An Holz. Britzelmayer: Lichenes der Algäuer Alpen (ohne Fundort, Kuťák). - Pusterthal bei Bad Maistadt (Toblach, Herb. Kuťák).'

Type: No type material has been located.

This taxon was characterized as having an immersed thallus, but a very thin or immersed thallus is not uncommon in ***Calicium lenticulare* Ach. of which *C. schaereri* sensu Nádvorník is a synonym** (see also 'carpatica').

aurea
Chaenotheca hispidula f. *aurea* Nádv. 1942a: 26.
'Ostkarpathen: Svalava: auf dem Munčel bei Ždeňová, 1100 m, an Tannenrinde (1933!). - Slowakei: V. Tatry: Bielovodská dolina, an Fichtenrinde, 1200 m (1933!, Stiel hie und da gabelig geteilt).'

Type: '*Chaenotheca hispidula* f. *aurea*, Rossia Subcarpathica: Svalava: in monte Munčel, in cort. *Abietis*, 1100 m, 4.6.1933 leg. et det. Nádv. (BRA, lectotype, designated by Tibell, 1980: 36).

Nádvorník characterized this taxon as having short ascomata with spherical capitula with a yellow pruina below and a moderately developed excipulum. Pruinosity and ascomata size and height varies considerably and continuously in *Ch. hispidula* and we find it difficult to identify an infraspecific taxon on the basis of these characteristics. **The lectotype is well accommodated in the variation encountered in *Ch. hispidula* (Ach.) Zahlbr.** (Tibell, 1980: 36).

Chaenotheca hispidula occurs on wood and bark of both deciduous and coniferous trees, in shaded to rather open habitats, and is widely distributed in both hemispheres.

brachysporum
Cyphelium brachysporum Nádv. 1942b: 133.
USA, 'California: Murietta Riverside, an Holz, 1903 leg. H. E. Hasse' (Hb. Kuťák).'

Type: USA, 'Riverside, an Holz, 1903 leg. H. E. Hasse' (BRA, lectotype designated here).

Since no material from Hb. Kuťák has been located this material is designated as lectotype.

Nádvorník characterized this species as similar to *C. tigillare* (Ach.) Ach. ('*Cyphelium viridescens* f. *prominula*') but differing in having much smaller spores, indicating a spore size of 11-13 x 8.5-10 μm. The specimen from BRA, however, contained a mixture of 1-septate and submuriform spores in the range of 14-16 x 12-14 μm, well agreeing with the spore size of *C. notarisii,* which is characterized by the spores being submuriform when they are mature. **The specimen examined represents *Cyphelium notarisii* (Tul.) Blomb. & Forss., and thus *C. brachysporum* is a synonym of this species.**

Cyphelium notarisii occurs on dry, weathered wood and rarely on bark. It is a widely distributed, but rare species in the temperate areas of the Northern Hemisphere (Tibell, 1971, 1999).

calicioides
Sphinctrinella calicioides Nádv. 1942b: 138.
'U.S.A.: Iowa: Fayette Co., an Holz von Cedrus, 1896 leg. Fink ("*Calic. parietinum*", Herb. M.).'

Type: USA, '*Calicium parietinum*. On cedar. Fayette Co., Ia., 1896 coll. B. Fi.' (UC, isotype). Loan of original material was requested from M, but no such material could be located.

The name adopted for this taxon is *Mycocalicium calicioides* (Nádv.) Tibell (Tibell, 1984: 672). It is only known from a few localities in the USA, Mexico, Central America and Africa.

Mycocalicium calicioides occurs on weathered wood in rather open situations in cool temperate to subtropical areas, from lowlands to 1500 m altitude.

carpatica
Caliciella carpatica Nádv. 1934: 307.
'ČSR, Podkarpatská Rus (Karpathorussland): Volové: im Tal des Hradobec-Baches der Polonina Hrabová, an einem senkrechten Schieferfelsen, 700 m (Typus in hb. meo).'

Type: '*Caliciella carpatica,* Rossia Subcarpathica: Volové: in valle rivi Hradobec in monte Hrabová, ad saxa arenosa, 700 m, 15.VIII.1932 leg. et det. Nádv.' (BRA, holotype).

The type represents *Calicium lenticulare* Ach. The clavate asci, the broadly ellipsoid spores with an areolate surface, the thick thallus, the white pruinose apothecia and the I+ blue reaction of the stalk (in section) are characteristic for *C. lenticulare*.

Nádvorník first followed Vainio (1927) in recognizing the genus *Caliciella* as separate from *Calicium*. Later Nádvorník (1942a) included *Caliciella carpatica* in *Calicium schaereri* (*C. lenticulare*) distinguishing it as a form of this species.

Calicium lenticulare occurs on wood and bark of both deciduous and coniferous trees in wet and shaded habitats. It is a very widely distributed species in cool temperate to subtropical areas of both hemispheres, but it only rarely occurs among decaying mosses on soil.

compressa
Tylophorella polyspora f. *compressa* Nádv. 1942b: 136.
'Nova Granata, Houda, 250 m, leg. Lindig 2891' (herb. W no. 11855 p. p., holotype).

Type: Colombia, ' Nova Granata, Houda, 250 m, leg. Lindig 2891' (herb. W no. 11855 p. p., holotype; BRA, isotype).

This taxon was described by Nádvorník from a part of a Lindig collection also including the type of *Tylophorella polyspora* Vain. Nádvorník characterized f. *compressa* as having more or less elongated ascomata. There is, however, a considerable and continuous variation in ascoma shape from orbicular to elongated in the Lindig 2891 material and also in other collections (Egea & Tibell, 1993), and we find it difficult to identify an infraspecific taxon on the basis of these characteristics. **The name adopted for this taxon is *Tylophorella pyrenocarpoides* (Müll. Arg.) Egea** (Egea & Tibell, 1993).

Tylophorella pyrenocarpoides occurs on bark in tropical forests. It is only known from Colombia and Venezuela in South America (Tibell, 1996) and from Africa.

consociatum
Calicium consociatum Nádv. 1942a: 10.
'Slowakei: V. Tatry: Štrba-See, an Rinde von *Larix*, 1400 m, 1935, leg. Nádv. (mit *Ch. chrysocephala*). - China: Prov. Yünnan, an Rinde von *Abies* mit *Ch. chrysocephala* f. *filaris,* 3925 m (Handel-Mazzeti, Iter sinense. No. 4566 in Herb. Wien).'

Type: '*Calicium consociatum,* Slovakia: Vysoké Tatry: Štrbské pleso, 19.8.1935 leg. et det. Nádvorník' (BRA, lectotype, designated here).

The name adopted for this taxon is *Chaenothecopsis consociata* (Nádv.) A. F. W. Schmidt (Schmidt, 1970: 148).

Chaenothecopsis consociata occurs on the thallus of *Chaenotheca chrysocephala* growing on bark of coniferous or rarely deciduous trees. Widely distributed in the Northern Hemisphere.

cretzoiui
Calicium cretzoiui Nádv. 1937: 16.
'Romània: Distr. Braşov: in montibus Bucegi, valle Mălăeşti, ad lignum *Piceae,* alt. 1300 m s. m. Leg. P. Cretzoiu, 2.V.1936.'

Type: '*Calicium Cretzoiui,* Distr. Braşov: in montibus Bucegi, in valle Mălăeşti, ad lignum *Piceae,* alt. 1300 m s. m. - Leg. P. Cretzoiu, 2.V.1936' (BRA, lectotype, designated here).

Three specimens of *C. cretzoiui* with identical label date are deposited in BRA. One of them has here been designated lectotype of *Calicium cretzoiui*. The description clearly indicates that the ascomata of *C. cretzoiui* has a yellow pruina on the mazaedium, and such ascomata in the lectotype belong to *C. adspersum* Pers. The lectotype also contains apothecia of *C. salicinum* Pers.

Exsiccata examined: Cretzoiu, Lich. Rom. exs. 12 (BRA, LE, isolectotypes); Nádvorník, Cal. exs. 22 (BRA, UPS, isolectotypes).

dilatata
Chaenotheca dilatata Räs. in Nádv. 1942a: 21.
'In Finnland an Rinde'

Type: '*Chaenotheca dilatata.* Fennia: St, Kankaanpää, Venesjärvi, Kiimahahka. Ad corticem *Pini silvestris*, leg. 1936 Matti Laurila' (ex herb. Räsänen, H, lectotype, designated here; BRA, isolectotype).

The lectotype has short-stalked ascomata, but stalk length is highly and continuously variable in *Ch. ferruginea*, and we find it difficult to identify an infraspecific taxon as described here. **The lectotype represents *Chaenotheca ferruginea* (Turn. ex Sm.) Migula** (Tibell, 1980: 32).

Chaenotheca ferruginea occurs in shaded to open habitats on wood and bark of both deciduous and coniferous trees. It is a widely distributed species occurring in both hemispheres and tolerating rather high levels of air pollution. In polluted areas it has a competitive advantage over many lichens and may be quite frequent, although it is usually sterile.

ecrustacea
Cyphelium inquinans f. *ecrustacea* Nádv. 1942a: 12.
'Böhmerwald: Fallbaum bei Eisenstein, an Holz von *Abies* (1923, Hilitzer).'

Type: '*Cyphelium inquinans* f. *ecrustacea,* Šumava: Eisenstein, Fallbaum, 1923 leg. Hilitzer, det. Nádvorník' (BRA, lectotype, designated here).

This taxon was characterized by having an almost immersed thallus, but this is not rarely seen in *C. inquinans*, which varies from having this type of thallus to a quite thick verrucose thallus. We thus find it difficult to identify an infraspecific taxon on the basis of this. **The lectotype represents *Cyphelium inquinans* (Sm.) Trevis.**

Cyphelium inquinans occurs on wood and bark of both hardwoods and conifers in rather shaded to open habitats. It also often occurs on man-made substrates such as wooden fences and wooden walls of barns. It is widely distributed in cool to temperate areas of both Hemispheres.

endochrysea
Cyphelium viridescens var. *endochrysea* Nádv. 1942b: 133.
'U.S.A.: Essex, Massachusetts, 1849 leg. Oakes (Herb. Farlow, 1 p. p., M).'

Type: USA, 'Essex, Massachusetts, 1849, leg. Oakes' (BRA, syntype). Loan of original material was requested from M, but no such material could be located.

The syntype represents *Cyphelium tigillare* Ach.

Cyphelium tigillare occurs on dry, weathered wood, on worked timber and also on bark and wood of trees. It is a widely distributed species in the temperate to cool-temperate areas of the Northern Hemisphere (Tibell, 1971, 1999).

faginea
Chaenothecopsis faginea Nádv. 1942a: 31.
'Slowakei: Vepor Klenovský, "Vatra", 1200m (Suza). - Ostkarpathen: Užok-Pass: Čeremcha, 900 m (1930!). - Kinčik Hnylský, 1100 m (1933!). - Lysý Pohár bei Černoholová, 350 m (1935!). - Kosovská rika, 800 m (1927 Suza).'

Type: '*Chaenothecopsis alboatra* var. *faginea* Nádv. Rossia Subcarpathica: Užok: in monte Kinčik hnylský, ad cort. *Fag*., 1100 m, 5.VI.33' (BRA, lectotype, designated by Schmidt, 1970: 148, corrected after label data).

Nádvorník (1942a) described this taxon as having non-septate spores, *Trentepohlia* as photobiont, a negative K reaction of the ascomata, and as occurring on *Fagus* bark. Schmidt (1970) accepted *Ch. faginea*, and described further details such as the apical part of the asci being penetrated by a fine canal and also confirmed the negative K reaction. Our investigation of the lectotype showed the stalk to turn reddish gray with K. In sections, the hyphae of the excipulum and stalk have a red tinge after HNO_3 has been added. Similar reactions also occur in *Ch. debilis*, which, however, has one-septate spores. *Ch. debilis* is, however, not associated with *Trentepohlia* as photobiont. Nádvorník's description is very brief, and gives little guidance for designating a lectotype. **We are thus not sure what taxon Schmidt's lectotypification identifies and we do not understand Schmidt's concept of *Ch. faginea.***

farinosum
Allophoron farinosum Nádv. 1942b: 137.
'Nova Granata: Bogota, 2600 m, an Rinde von *Quercus*, Lindig 2633 mit *Tylophoron protrudens* in Herb. M.'

Type: '*Tylophoron protrudens* Nyl. Nova Granata, Bogota, ad cort. *Quercus*, alt. 2600 metr., herb. Lindig 2633', with annotation: '1. *Tylophoron protrudens* Nyl. 2. *Allophoron farinosum* Nádv. Orig. spec., rev. Nádvorník 1941' (M, holotype).

Allophoron farinosum is known only from the type locality in Colombia (Tibell, 1996), where it occurs on bark of *Quercus* at 2600 m altitude.

filaris - 1
Chaenotheca servitii f. *filaris* Serv. & Nádv. 1936: 5.
'*Ch. Servítii* f. *filiaris* (sic!), O. Slovakei, Pavlovce bei Velké Kapušany, an morschen Baumstümpfen von *Salix*, 105 m.'

Type: '*Chaenotheca Servítii* f. *filaris*, V. Kapušany: Pavlovce 110 m, ad lign. *Salicis*, 1933 leg. et det. N.' (BRA, lectotype, designated by Tibell, 1980: 45).

Nádvorník described this taxon as being characterized by having very tall ascomata. In our experience, however, there is a considerable and continuous variation in ascoma height in *Ch. servitii*. **The lectotype represents *Chaenotheca servitii* Nádv.** (Tibell, 1980: 45).

Chaenotheca servitii is a rare species occurring on wood of deciduous trees in old-growth forests. Originally described from Slovakia, it has also been reported from the Caucasus (Titov, 1998) and North America (Selva & Tibell, 1999).

filaris - 2
Chaenotheca hispidula f. *filaris* Nádv. 1942a: 26.
'Ostkarpathen: Užhorod: bei Strypa u. Horjany, an Eichenrinde (!).'

Type: '*Chaenotheca hispidula* f. *filaris,* Rossia Subcarpathica: Užhorod: Rozputi vrch u Strypy, *Quercus,* 1.V.1932 leg. et det. Nádv.' (BRA, lectotype, designated by Tibell, 1980: 36).

This taxon was described by Nádvorník as characterized by having slender and heavily pruinose ascomata. There is, however, a considerable and continuous variation in both ascoma height and pruinosity in *Ch. hispidula*. **The lectotype represents *Chaenotheca hispidula* (Ach.) Zahlbr.** (Tibell, 1980: 36; see also 'aurea').

flava

Chaenotheca servitii f. *flava* Serv. & Nádv. 1936: 5.
'*Ch. Servítii* f. *flava*, O. Slovakei, Pavlovce bei Velké Kapušany, an morschen Baumstümpfen von *Salix*, 105 m.'

Type: '*Chaenotheca Servítii* f. *flava,* V. Kapušany: Pavlovce, *Salix,* 110 m, 1933 leg. et det. N' (BRA, lectotype, designated by Tibell, 1980: 45).

This taxon was characterized by Nádvorník as having moderately tall ascomata. **The lectotype represents *Chaenotheca servitii* Nádv.** (Tibell, 1980: 45), see also 'filaris - 1'.

glaucescens

Calicium viride var. *glaucescens* Nádv. 1934: 307.
'ČSR, Vysoké Tatry (Hohe Tatra): im Tal Mlýnice, auf der Rinde von Fichte, 1400 m (Original in hb. meo).'

Type: '*Calicium viride* f. *glaucescens,* Vysoké Tatry: in valle Mlýnice, 1400 m, 4.7.1933 leg. et det. Nádvorník, Typus!' (BRA, holotype).

Nádvorník described this taxon as having a sorediate thallus and a greyish pruina on the ascomata. The thallus varies considerably in *C. viride*, as does the occurrence and colour of the pruina (lacking, brown or greyish). Specimens with a dissolving or almost sorediate thallus are not rare, and a greyish pruina sometimes occur. These features, however, are not linked and we find it difficult to identify an infraspecific taxon on the basis of these characteristics. **The holotype represents *Calicium viride* Pers.**

Calicium viride occurs on wood and bark of trees and is widely distributed in the temperate to cool-temperate areas of the Northern Hemisphere. It is also known from southernmost South America (Tibell, 1998).

gracilis - 1

Coniocybe farinacea f. *gracilis* Nádv. 1934: 309.
'ČSR, Karpathorussland: Am Fluss Kosovská rika, 600 m, auf Rinde von *Acer pseudoplatanus*, leg. J. Suza (Typus in hb. Suza).'

Type: '*Coniocybe farinacea* f. *gracilis*. Rossia Subcarpathica (ČSR): m. Svidovec: in valle fluvii Kosovská rika, ca 600 m, *Acer pseudoplatanus.* 1925 leg. J. Suza, 18.XII.1933 det. J. Nádvorník' (herb. Suza - PRM 586283, holotype, BRA, isotype).

This taxon was characterized by Nádvorník as having long and slender stalks. *Sclerophora farinacea* varies considerably and continuously in ascoma height and stalk thickness, and we find it difficult to identify an infraspecific taxon on the basis of these characteristics. **The holotype represents *Sclerophora farinacea* (Chevall.) Chevall., the adopted name for this taxon.**

Sclerophora farinacea mainly occurs on bark of deciduous trees in open to semi-shaded habitats in old-growth deciduous forests. It is rare, but widely distributed in the temperate zone of the Northern Hemisphere.

gracilis - 2
Chaenothecopsis gracilis Nádv. 1936: 55.
'Velký Berezný: na kůře *Abies alba* u Černoholové, 350 m. Perečín: Lumšur, 600 m, *Abies*.'

Type: '*Chaenothecopsis gracilis,* V. Berezný: Černoholová, *Abies alba,* 350 m, 13.X.1935 leg. J. Nádvorník (J. Nádv. Cal. exc. 15; BRA, lectotype, designated here; isolectotypes: H, UPS).

The lectotype represents *Chaenothecopsis rubescens* Vain. Several of the features mentioned in the protologue support this, i. e. the association with *Trentepohlia*, the size and K+ red reaction of the ascomata and the non-septate spores. *Ch. gracilis* was accepted as a distinct species by Schmidt (1970: 147), who, however, also noted a close relationship between *Ch. gracilis* and *Ch. rubescens*.

Chaenothecopsis rubescens occurs on the bark of deciduous and rarely of coniferous trees in cool temperate to temperate areas of the Northern Hemisphere. It is a rare species in Europe, but in some regions as the Caucasus (Titov, 1998), the Russian Far East (Titov & Tibell, 1993), Western Sichuan (Titov, 2001) and North America (Selva, 1988) it is rather common. The species was recently reported from Brazil (Aptroot, 2002).

Exsiccata examined: Nádvorník, Cal. exs. 15 (BRA, UPS).

gyrocarpa
Calicium salicinum f. *gyrocarpa* Nádv. 1940a: 119.
'Eh. Karpathorussland: Lysý Pohár bei Černoholová, an Rinde von *Abies* (1935 Nádv.).'

Type: '*Calicium salicinum* f. *gyrocarpa,* Vel. Berezný: in monte Lysý pohár pr. pag. Černoholová, *Abies,* 13.10.1935 leg. et det. Nádv., Typus' (BRA, holotype).

This taxon was characterized by the elongated and deformed capitula of the ascomata and the broadly-ellipsoidal asci containing spores in two rows. Our investigations showed the holotype to contain several deformed ascomata without asci and spores. In addition, and evidently belonging to the same thallus, apparently healthy ascomata, containing cylindrical asci with uniseriate spores were found. This type of deformed and usually sterile ascomata has been observed in other specimens of *C. salicinum* and also in other *Calicium* species, and we find it difficult to identify an infraspecific taxon on the basis of these characteristics. **The holotype represents *Calicium salicinum* Pers.**

Calicium salicinum occurs on wood and bark of trees and is widely distributed in cool-temperate to subtropical areas of both hemispheres (Tibell, 1999).

huculicum
Calicium huculicum Nádv. 1942a: 10.
'Ostkarpathen: Rachovo: Balzatul, 1100 m, an Fichtenrinde, 1935, leg. Nádv.'

?Type: '*Calicium huculicum,* Rossia Subcarpathica: Černá hora: Klausura Balsatul, ad cort. *Piceae,* 1100 m, 23.8.1935 leg. et det. Nádv., orig.' (BRA).

A specimen that fits the locality data of the protologue in BRA only contains *C. viride*. It is, however, evident that ***C. huculicum* refers to a quite different species most probably belonging to *Chaenothecopsis.*** If this collection is the original material all material of *C. huculicum* may have been lost. The description is very short and gives very little guidance for designating a neotype.

koerberi
Strongyleuma koerberi Nádv. 1934: 322.
'Exs. a me exam. M Arn. 1086 (hb. Wien, München). Lojka, Lich. Univ. 152 (Wien, Suza, München). Suza, Lich. Boh. Slov. 213 (hb. meo). ČSR, Užhorod: Bei Strypa, 180 m. Im Tal des Baches Syrový bei Kamenice, 250 m. Im Tal des Baches Krupco bei Onokovce, 220 m.'

Type: 'H. Lojka: Lichenotheca universalis 152 (W). *Calicium paroicum*. Super corticem *Fagorum* in colle "Satnitz" prope Klagenfurt in Carinthia. Dr. J. Steiner.', containing the label: '*Strongyleuma ochroleucum* (Krb.) Nádvorník X. 1933' (W, lectotype, designated by Tibell & Ryman, 1995: 208).

***S. koerberi* was transferred to *Chaenothecopsis,* as *Ch. koerberi* (Nádv.) Tibell** (Tibell, 1984: 666), **and later considered a synonym of *Ch. ochroleuca* (Koerb.) Tibell & K. Ryman** (1995: 208).

Chaenothecopsis ochroleuca occurs on the thallus of *Lecanora* sp. and on unidentified, sorediate lichen thalli growing on both hardwoods and conifers. It is a rare but widely distributed species known from Eurasia and North America.

kutakii
Chaenotheca melanophaea var. *kutakii* Nádv. 1942a: 20.
'Politz a. d. Mettau: Bischofstein, über Moosen (1918 Kuťák). Exs: Kuťák Lich. Bohem. 407 (!, MP)'. [Nádvorník´s 'MP' = National Museum, Prague, now PRM.]

No original material was found in BRA. In PRM there is a specimen annotated by Nádvorník in 1940: '*Chaenotheca melanophaea* var. *Kuťákii*'. The label reads: 'V. Kuťák Lichenes Bohemiae 403/1710. *Chaenotheca trichialis* Ach. Na mechu! ve Skalách. 1918 leg. V. Kuťák'. This indicates that the specimen was found on mosses, and the number of the collection does not agree with the protologue. The words 've Skalách' means 'in the rocks', as far as we understand, but since it was written by capital 'S' it might indicate the name of a locality. If the numbering is just an error and the locality would match, this collection could indeed be selected as a lectotype of *Chaenotheca melanophaea* var. *kutakii.* **The material agrees well with *Ch. ferruginea,* which occasionally grows on rocks.**

laevigata
Chaenotheca laevigata Nádv. 1934: 309.
'ČSR, Užhorod: Anhöhe Vel. Cikera, 220 m. Im Tal des Baches Packo bei Velké Lazy, 150 m. - Sobrance: Anhöhe Borola bei Chonkovce, 300 m. Überall an Eichen. - Polen: Krakov: auf der Rinde von *Betula* bei Tomaszovce, 1865; leg. H. Lojka (herb. Budapest).'

Type: '*Chaenotheca laevigata,* Užhorod: in monte V Czikera pr. pag. V. Německé, ad cort. *Querc* 210 m, 23.4.1933' (BRA, lectotype, designated by Tibell, 1980: 39).

Chaenotheca laevigata mainly occurs on wood of conifers in shaded to semi-open habitats. It is rare but widely distributed in the boreal zone of the Northern Hemisphere.

leprosa
Calicium viride f. *leprosa* Nádv. 1940a: 117.
'Aus England ...'

We have not been able to locate any type material of this taxon and thus **we do not know what the name refers to.**

lignicolum
Calicium lignicolum Nádv. 1940a: 128.
'An Holz von Nadelbäumen im Gebirge: Eh. Karpathorussland: Užok-Pass: Wodyiwsk, 900 m (1934 Nádv.). – Rachovo: Balzatul-Klausur, 1300 m (1935 Nádv.). – Rumänien: Bucegi: zwischen Gura-Dihamuliu und Posana-Moralului, 1200 m (1936 Cretzoiu). – Schweiz: Saléve bei Genf (Müller, "*C. pus.* v. *sublile*").'

Type:'*Calicium lignicolum,* Rossia Subcarpathica: Montes Černá hora: Klauzura Balzatul, 1300 m, 23.8.1935 leg. et det. N 1939, original' (BRA, holotype).

The name adopted for this taxon is *Chaenothecopsis pusiola* (Ach.) Vain. (Tibell, 1987a).

Chaenothecopsis pusiola is usually associated with *Chaenotheca trichialis*, *Ch. xyloxena* and *Ch. gracillima,* occurring on wood of coniferous, rarely deciduous trees in shaded and humid habitats. It is widely distributed in boreal areas of the Northern Hemisphere, and is also known from New Zealand (Tibell, 1987b).

marianum
Embolidium marianum Nádv. 1938: 2.
'Aux rameaux fins d'aune dans la vallée au pied de la colline Bolosňak près de Sinevírská Polana, 900 m s. m. (La Russie Suscarpathique).' (Sic!)

Type: '*Calicium marianae* Nádv. n. n., Poloninské Karpaty: u potůčku nad klauzurou Fultovec u Sinevírské Polany, tenké větvičky olše, 900 m, 1936 leg. J. Nádvorník' (BRA, holotype).

The name adopted for this taxon is *Calicium adaequatum* Nyl. (Tibell, 1975).

Calicium adaequatum occurs on twigs and more rarely on branches or thin stems of deciduous trees in cool temperate areas. It is widely distributed in the Northern Hemisphere and also known from South America (Tibell, 1998).

minima
Coniocybe farinacea f. *minima* Nádv. 1934: 309.
'ČSR, Karpathorussland: Užok-Pass: auf dem Kinčik hnylský, 1100 m, *Fagus'*. - Slowakei: Snina: auf der Babia skála bei Nová Sedlice, 900 m, *Fagus*.'

Type: '*Coniocybe farinacea* f. *minima,* Užok: in monte Kinčik hnylský ad cort *Fag.* 1100 m, 5.6.1933 leg. et det. N.' (BRA, lectotype, designated here).

The lectotype represents *Sclerophora farinacea* (Chevall.) Chevall., the adopted name for this taxon (see also 'gracilis - 1').

moravica
Chaenotheca carthusiae f. *moravica* Nádv. 1942a: 22.
'Mähren: Žákova hora, am Holz (Kovář).'

No material has been located in BRA, neither in PRM. **The name remains doubtful.**

norvegica
Calicium trabinellum var. *norvegica* Nádv. 1940a: 122.
'In Norwegen, an Holz. Havaas 141 (MP, orig. sp.).'

No material was obtained from PRM. A specimen of Havaas 141 (isotype), deposited in LE belongs to *Calicium trabinellum* Ach.

Nádvorník characterized this taxon as having a moderately well developed thallus and constricted spores. Although *C. trabinellum* usually has a completely immersed thallus, a thin or moderately thick thallus is sometimes found. The spore shape is also variable, and we find it difficult to identify an infraspecific taxon on the basis of these characteristics. **The isotype represents *Calicium trabinellum* (Ach.) Ach.**

Calicium trabinellum mainly occurs on wood of conifers and is widely distributed in cool to cool-temperate areas of both hemispheres.

nuda - 1
Calicium quercinum f. *nuda* Nádv. 1940a: 125.
'Mähren: Třebíč: Heraltice (1912 Suza). Račerovice (1906 Dvořák). An Holz.'

Type: '*Calicium quercinum* f. *nuda,* Moravia: Třebíč: supra lignum *Querc.* in Heraltice 1912 leg. Suza, det. Nádv.' (BRA, lectotype, designated here).

This taxon was characterized by not having a white pruina on the apothecia. The lectotype has a thick, gray, granular and K+ yellow-red thallus characteristic of *C. quercinum*, and also a slight pruina on some apothecia, possibly overlooked by Nádvorník. We thus find it difficult to identify an infraspecific taxon on the basis of these characteristics. **The lectotype represents *Calicium quercinum* Pers.**

Calicium quercinum occurs on bark, rarely on wood of deciduous trees in old-growth forests. It is a rare and in several countries red-listed species occurring in the temperate areas of the Northern Hemisphere.

nuda - 2
Calicium adspersum f. *nuda* Nádv. 1942a: 8.
'Nordfriesische Insel Röm, an Phählen bei Tagholm, 1929, leg. Erichsen.'

Type: '*Calicium adspersum* f. *nuda,* Nordfriesische Insel Rőm, an Pfählen bei Tagholm, 24.7.1929 leg. C. F. E. Erichsen, Hamburg, Nr. 513 (= Nr. 435)' (BRA, lectotype, designated here).

This taxon was described as having small and epruinose apothecia, but both these features are highly variable in *C. adspersum*, and we find it difficult to identify an infraspecific taxon on the basis of these characteristics. **The lectotype represents *Calicium adspersum* Pers.**

Calicium adspersum occurs on bark of old trees, rarely on wood, particularly of *Quercus,* rarely also on other deciduous trees and conifers. It is a rather rare, but widely distributed species known from Europe, North America, the Russian Far East, and also from Australia (spp. *australe*) and South America (Tibell, 1999).

obscurata
Sphinctrina obscurata sensu Nádv. 1942a: 36.

Type: France, 'Foret de Vibraye (Sarthe), über *Pertusaria* (1909 Monguillon)' (not seen).

The name adopted for this taxon is *Sphinctrina leucopoda* Nyl. (Löfgren & Tibell, 1979).

Sphinctrina leucopoda occurs on *Pertusaria* spp., growing mainly on deciduous, sometimes coniferous trees, a rare species, but widely distributed in the boreal-temperate zone of the Northern Hemisphere, favouring an oceanic climate.

phaeopoda - 1
Coniocybe obscuripes f. *phaeopoda* Nádv. 1934: 324.
'Karpathorussland: Medzi jamami unter der Polonina Runa, auf der Rinde von *Abies*, 900 m (Typus in hb meo).'

Type: '*Coniocybe obscuripes* f. *phaeopoda,* Rossia Subcarpathica: Polonina Runa: Medzi jamami, ad cort. *Abietis* vetust. 22.8.1932 leg. et det. Nádv., orig!' (BRA, holotype).

This taxon was described by Nádvorník as having brownish or slightly translucent rather than black stalks. Decoloration of ascomata is not rare in calicioid species, and may be caused by loss mutations. This seems to be the case in some collections of *Calicium viride,* in which the stalk and excipulum is bright yellow rather than black - no fungal melanins seem to have been produced. But decoloration may also be associated with senescence, or particular ecological conditions. We thus find it difficult to identify an infraspecific taxon on the basis of these characteristics. **The holotype represents *Sclerophora coniophaea* (Norman) Mattsson & Middelborg,** the adopted name for this taxon.

Sclerophora coniophaea mainly occurs on bark, particularly of *Quercus,* in shaded habitats in old-growth forests or parklands, and in northern areas also on conifers. Particularly in northern areas it also occurs on wood. Although widely distributed in the boreal-temperate zone of Eurasia, and known from Europe, Caucasus, the Russian Far East, China and the Himalayas, it is rare and in many areas red-listed and threatened.

phaeopoda - 2
Chaenotheca melanophaea f. *phaeopoda* Nádv. 1942a: 20.
'Ostkarpathen: Perečín: Znamín, an Birkenrinde (!). - Slowakei: V. Tatry: nich selten (Suza, !). - Peninsula Taurika: Wasserfall Jalta, *Pinus taurica* (Lojka, Herb. Budap., "*Ch. cinerea* v. *Schaereri")*.'

Type: '*Chaenotheca melanophaea* f. *phaeopoda,* Rossia Subcarpathica: Perečín: in monte Znamín, *Betula,* 1931 leg. et det. N' (BRA, lectotype, designated by Tibell, 1980).

This taxon was described by Nádvorník as having a pale stalk basis. Decoloration of ascomata, and particularly of stalks, is not rare in calicioid species, and may be caused by loss mutations, senescence, or particular ecological conditions. We thus find it difficult to identify an infraspecific taxon on the basis of these characteristics. **The lectotype represents *Chaenotheca ferruginea* (Turn. ex Sm.) Migula**, the adopted name for this taxon (see also 'dilatata').

rappii
Mycocalicium rappii Nádv. 1942b: 139.
'Florida: Sanford: on Sabal Palmeto, 1930 leg. S. Rapp (W).'

Type: '*Mycocalicium Rappii* Nádv. Florida: Sanford on Sabal Palmetto. leg. S. Rapp, det. Nádv., cootyp!' (BRA, lectotype, designated here). No type material was located in W.

Additional specimen studied: USA, Florida, Duval Co., Jacksonville Beach, 1975 Buck B173 (NY).

***Chaenothecopsis rappii* (Nádv.) Tibell & Titov comb. nov.**

Basionym: *Mycocalicium rappii* Nádv., Annal. Mycol. 40: 139 (1942).

This species was characterized by its brown, wedge-shaped hypothecium and wide rounded to irregular cells of the excipulum. *Chaenothecopsis rappii* has a distinctive canal in the ascus apex thickening and this, and its stalk anatomy agrees well with *Chaenothecopsis* as presently conceived.

Chaenothecopsis rappii is only known from a few localities in Florida, where it occurs on bark of *Sabal palmetto* in flood plain forests.

reticulatum
Mycocalicium reticulatum Nádv. 1942b: 139.
'South Carolina: Torbil's Hill, an Holz, 1885 leg. H. A. Green ('*Calicium parietinum*', Hb. W)'.

Type: USA, '*Calicium lenticulare* (Hoffm), South. Carolina, H. A. Green. = *Mycocalicium reticulatum* Nádv.' (all in Nádvorník's hand, ex herb. Nádvorník, BRA, isotype).

No original material was located in W. **The isotype studied is similar to *Mycocalicium albonigrum* (Nyl.) Tibell and *M. victoriae* (C. Knight ex F. Wilson) Tibell, but cannot with certainty be identified with either of these species. It may represent a third species.**

rufescens
Chaenotheca servitii f. *rufescens* Serv. & Nádv. 1936: 4.
'O. Slovakei: Pavlovce bei Velké Kapušany, an morschen Baumstümpfen von *Salix*, 105 m.'

Type: '*Chaenotheca Servítii* f. *rufescens*, Nádvorník, Calic. exs. 6, ex herb. Servít' (PRM, lectotype designated by Tibell, 1980: 45).

Chaenotheca servitii f. *rufescens* is described by Nádvorník as the 'typical form'. **The lectotype represents *Chaenotheca servitii* Nádv.** (see also 'filaris - 1').

ruficeps
Chaenotheca hispidula f. *ruficeps* Nádv. 1942a: 26.
'Böhmen: Chotieborsch-Chotěboř: Rochňoves, an Eichenrinde (Senft, MP).'

Type: '*Chaenotheca hispidula* f. *ruficeps* Nádv. Bohemia: Chotěboř: Rochňoves, Quercicola, leg. Senft, det. Nádv.' (BRA, lectotype, designated by Tibell, 1980: 36).

Nádvorník characterized this taxon by its ferrugineous rather than yellow pruina on the lower side of the capitulum. Pruina colour, however, varies in *Ch. hispidula* gradually, sometimes even in the same specimen between yellow and ferrugineous, and we find it difficult to identify an infraspecific taxon on the basis of this feature. **The lectotype represents *Chaenotheca hispidula* (Ach.) Zahlbr.** (see also 'aurea').

rufocapillatum
Tylophoron rufocapillatum Nádv. 1942b: 134.
'Brasilien: Nova Granata: Chucuri(?), 1100 m, 1863 leg. Lindig (Herb. Lindig no. 38 sub *T. moderatum* Nyl., M, W). – Minas Geraés, Lafayette, 1885 leg. Wain.'

Type: '*Tylophoron moderatum* Nyl., Nova Granata, ? Chucuri, alt. 1100 m, 1863 Lindig 38' (M, lectotype, designated by Tibell, 1982: 252; BRA, W, isolectotypes).

Nádvorník characterized this taxon by the reddish colour of the paraphyses of the mazaedium. This type of pruinosity is, however, quite common in *Tylophoron protrudens*, although it is lacking in some collections. Also in other features it agrees well with ***T. protrudens* Nyl., which the lectotype represents** (Tibell, 1982: 252).

Tylophoron protrudens occurs on bark of trees in tropical to subtropical areas and is widely distributed in Central and South America. It is also known from South Africa and Borneo (Tibell, 1982, 1996).

servitii
Chaenotheca servitii Nádv. 1934: 308.
'ČSR, Slovakei: Velké Kapušany: an morschem Holz von *Salix* bei Pavlovce.'

Type: '*Chaenotheca Servítii,* Vel. Kapušany, Pavlovce *Salix,* 110 m, 1933 Nádv.' (BRA, lectotype designated by Tibell, 1980: 45; see also 'filaris' – 1).

simile
Tylophoron simile Nádv. 1942b: 136.
'Nova Granata, an Rinde, leg. Lindig (Herb. W. no. 11855).'

Type: '*Tylophoron moderatum* Nyl., Nova Granata, leg. Lindig 11855' with Nádvorník's label: '*Tylophoron simile* Nádv. orig. exempl., rev. Nádvorník 1941' (W, holotype; BRA: isotype).

In our judgment **the holotype represents *Tylophoron protrudens* Nyl**. (Tibell, 1982: 252), see also 'rufocapillatum'.

sphaerocephala
Chaenotheca sphaerocephala Nádv. 1942b: 134.
'Chile: Corral, an altem Holz, leg. Stockert (Hb. W).'

Type: '*Chaenotheca sphaerocephala*, Chile, Corral, leg. Stockert' (W, holotype; BRA, isotype).

Nádvorník indicated the granular-sorediate thallus, the small spores, the poorly developed excipulum, the often pruinose stalks of the apothecia and the trebouxioid photobiont to be characteristic for this species. A more detailed description of ***Chaenotheca sphaerocephala*** was given by Tibell (1998: 56).

Chaenotheca sphaerocephala occurs on bark and wood of coniferous and deciduous trees in humid situations. Originally described from Chile, it has also been reported from Argentina (Tibell, 1998), North America (Selva & Tibell, 1999), Sweden (Tibell, 1999) and China (Titov, 2001). It is probably widely distributed in both hemispheres, but still overlooked.

subcrustosa
Calicium quercinum f. *subcrustosa* Nádv. 1940a: 125.
'Eh. Karpathorußland: Kamenica, *Acer pseudoplatanus*, 200 m (1931 Nádv.). Ungarn: "montes Bűkk, ad cort. *Ulmi* in valle Pajzaki vőlgy pr. Zsérc, 350 m" (No. 5285 hb. Fóriss, hb. m.).'

Type: '*Calicium quercinum,* Vihorlat: vrch Temník u Kamenice *Acer,* 200 m, 6.IX.1931' (hand-written label), and in addition a printed label for the exsiccata: 'J. Nádvorník: Calicieae exsiccatae. Dec. V. 1940. *Calicium quercinum* f. *subcrustosa*, Rossia Subcarpathica: in monte Temník pr. Kamenica, ad corticem *Aceris pseudoplatani,* 200 m. 6. VI. 1931 leg. Nádvorník.' (BRA, lectotype, designated here; H, UPS, isolectotypes).

Nádvorník characterized this taxon by its thin thallus. Thallus thickness, however, varies in *C. quercinum*, and we find it difficult to identify an infraspecific taxon on the basis of this feature. **The lectotype represents *Calicium quercinum* Pers.** (see also 'nuda').

Exsiccata examined: Nádvorník, Cal. exs. 43 (BRA, UPS).

subferruginea
Chaenotheca trichialis f. *subferruginea* Nádv. 1942a: 23.
'Slowakei: V. Tatry: Štrbské pleso, *Larix,* 1300 m (1935!). – Mähren: Strání: auf der Hrabina, *Quercus,* 600 m (1940!). – Böhmen: Planiau-Pláňavy bei Hlinsko, an Tannen- und Erlenrinde, 6-650 m (!). Chotieborsch-Chotěboř: auf dem Babylon bei St. Ransko, *Picea,* 550 m (1933!).'

Type: '*Chaenotheca trichialis* f. *subferruginea*. Vys. Tatry: Štrbské pleso, *Larix*, 19.8.1935 leg. et det. N' (BRA, lectotype, designated by Tibell, 1980: 52).

Nádvorník characterized f. *subferruginea* as having almost spherical capitula, a granular thallus and by lacking a pruina of the ascomata. However, capitulum shape, thallus development and pruinosity vary considerably and independently in ***Chaenotheca trichialis*** **(Ach.) Th. Fr., which the lectotype undoubtedly represents** (Tibell, 1980: 52).

Chaenotheca trichialis occurs on wood and bark of both deciduous and coniferous trees and is widely distributed in both hemispheres.

subfilaris
Chaenotheca chrysocephala f. *subfilaris* Nádv. 1942a: 17.
'Tirol: alte Tanne im Walde zw. Carhsturm u. Kindenwald (1873, Arn.). - Bayern: Mittenwald an Fichten (Kremphbr.) - Schweiz: Rottenbach (Schaer.). - Ostkarpathen: Hrabová bei Volovec, *Abies* (1936!). - Užok-Pass: im Walde Wodyiwsk, 900 m, *Abies* (1923!).'

Type: '*Chaenotheca chrysocephala* f. *subfilaris* Nádv., Užok: in valle rivi in silva Wodyiwsk, ad cort. *Abiet*., 900 m, 5.VI.1933' (BRA, lectotype designated by Tibell, 1980: 27). It is likely that the collecting year '1923' in the protologue is a misprint for 1933.

Nádvorník characterized f. *subfilaris* as having tall ascomata with pale stalks covered by a yellow pruina. However, ascoma size and pruinosity vary considerably in *Ch. chrysocephala*, and not rarely the specimens have in part pale stalks. Therefore we find it difficult to identify an infraspecific taxon on the basis of these characteristics. **The lectotype represents *Chaenotheca chrysocephala* (Ach.) Th. Fr.** (Tibell, 1980: 27).

Chaenotheca chrysocephala occurs on wood and bark of both deciduous and coniferous trees, in shaded to open habitats. It is widely distributed in both hemispheres.

Exsiccata examined: Nádvorník, Cal. exs. 48, 49.

subfusca
Chaenotheca trichialis f. *subfusca* Hazsl. ex Nádv. 1942a: 22.
'Slowakei: Prešov: an Eichenrinde (Hazslinszky). - Ukraine: bei Kijev (Oxner). Düngelau bei Ingolstadt (1868 Arn.).'

Type: '*Chaenotheca trichialis* f. *phaeopoda* = f. *subfusca*, Alte Eiche der Donau-Auen südlich Düngelau bei Ingostadt (sic!) 1868 Arnold' (BRA: lectotype, designated by Tibell, 1980: 52.).

Nádvorník characterized f. *subfusca* as having a thin rim of pruina at the edge of the excipulum only, and by having at least in part a pale stalk. However pruinosity varies considerably in *Chaenotheca trichialis* and the pruina may even sometimes be lacking completely. We find it difficult to identify an infraspecific taxon on the basis of these characteristics. **The lectotype represents *Chaenotheca trichialis* (Ach.) Th. Fr.** (Tibell, 1980: 52; see also 'subferruginea').

subhispidula
Chaenotheca phaeocephala var. *subhispidula* Nádv. 1942a: 19.
'Ostkarpathen: Rachovo: Balzatul-Klause, Fichtenrinde, 1100 m (1935!). Hoverla, Fichtenrinde, 1650 m (1930!). Volové: Kanč, *Picea,* 1050 m (1936!) - Slowakei: V. Tatry, Kriváň, *Picea,* 1150 m (Timkó). N. Tatry: Lapinová bei Teplička (1872 Lojka). Vepor Klenovský, "loco Pálenica", 1100 m, *Abies* (1937 Suza). - Böhmerwald: Buchwald, 1200 m (1885 P. Hora). - Thüringen: Klingetal bei Oberhof-Stutzhaus, *Picea*, 700 m (nach Lettau) - Tirol: Paneveggio (*Picea*, leg. Arn.).'

Type: *Chaenotheca phaeocephala* var. *subhispidula* Nádv. 'Montes Černá hora: Klauzura Balzatul, 1100 m, 23.8.35 leg. et det. N' (BRA, lectotype designated by Tibell, 1980: 49).

The lectotype represents quite characteristic material of *Chaenotheca subroscida* (Eitner) Zahlbr. (Tibell, 1980: 49).

Chaenotheca subroscida usually occurs on bark of *Picea* spp., and is widely distributed in Europe and North America. It is also known from Caucasus (Titov, 1998).

subhyperellum
Calicium subhyperellum Nádv. 1940a: 118.
'Auf *Pseudotsuga macrocarpa.* Jasemite, Calif., 1900 Hasse (MP).'

Type: USA, 'Auf *Pseudotsuga macrocarpa.* Yosemite, Cal., 1900 Hasse' ex herb. Hasse with annotation: '*Calicium subhyperellum* n. sp. ad int. 5.II.1940 Rev. Nádvorník' (PRM, holotype).

The holotype represents quite characteristic material of *Calicium viride* Pers., and has a well-developed thallus.

Calicium viride occurs on wood and bark of trees and is widely distributed in the temperate to cool-temperate areas of the Northern Hemisphere. It is also known from southernmost South America (Tibell, 1998).

suzai
Chaenotheca suzai Nádv. 1936: 54.
'Černá hora: Klauzara Balzatul, na zetlelém smrkovém kmeni, 1300 m.'

Type: '*Chaenotheca Suzai* Nádv. Montes Černá hora: Supra Klauzura Balzatul, 1100 m, ad lignum putridum, 24.8.1935 leg. et det. Nádv. Typus.' (BRA, holotype).

The holotype represents quite characteristic material of *Chaenotheca chlorella* (Ach.) Müll. Arg. (Tibell, 1980: 26, 1987a: 262; see also 'moravica').

umbrosa
Chaenotheca chrysocephala f. *umbrosa* Nádv. 1942a: 17.
'Ostslowakei: Strážské bei Humenné, 180 m, an Eichenrinde (1936!). - Ungarn: Vas: bei Tarcsa, 360 m, Eichenrinde (1916 Fóriss, No. 3963).'

Type: '*Chaenotheca chrysocephala* f. *umbrosa* Nádv., Humenné, pr. pag. Stražské, 180 m, 19.9.1936 leg. et det. N.' (BRA, lectotype designated by Tibell, 1980: 27).

Nádvorník characterized f. *umbrosa* as having short-stalked ascomata and pale stalks. However, stalk length and stalk width varies considerably in *Ch. chrysocephala*. Decoloration of the stalk is not uncommon in *Ch. chrysocephala* and may be associated with senescence, or particular ecological conditions. We find it difficult to identify an infraspecific taxon on the basis of these characteristics. **The lectotype represents *Chaenotheca chrysocephala*.(Ach.) Th. Fr.** (Tibell, 1980: 27; see also 'subfilaris').

vainioanum
Calicium vainioanum Nádv. 1940a: 128.
'Znaim: Erdberg (Hrádek), an Eichenrinde (1922 Suza). - Hierher gehört vielleicht auch Nyl. Paris 105.'

'Calicium Vainioanum, Embolidium Italicum, Hrádek nad Dyjí, *Quercus*, 1922 Suza' 'Cootyp' (BRA, syntype).

The name adopted for this taxon is *Chaenothecopsis vainioana* (Nádv.) Tibell (Tibell, 1981: 57-59).

Chaenothecopsis vainioana occurs on bark of deciduous trees, mainly *Quercus*, in association with colonies of free-living algae, or lichen thalli containing *Trentepohlia*. It is a rare species, which usually occurs in old-growth forests, often in open habitats. The species is only known to occur in Europe, Caucasus and South America (Tibell, 1998).

viridireagens
Calicium viridireagens Nádv. 1940a: 129.
'Eh. Karpathorussland: Lysý Pohár bei Černoholova (Nádv.). Sinevírská Polana: Fultovec-Klausur, 900 m (1936 Nádv.). - Slowakei: V. Tatry: Bielovodská dolina, 1200 m (1933 Nádv.). - Rumänien: Bucegi: Gura-Duhamului (1936 Cretzoiu). Frankreich: Hautes Pyrénées: Cauterets (1921 Jeanjean et Fiton).'

Type: '*Calicium viridireagens,* Rossia Subcarpathica: Velký Berezný: in monte Lysý pohár pr. pag. Černoholová, 350 m, ad lignum *Abiet*., 5.IX.1936 leg. et det. Nádv.' (BRA, lectotype, designated here).

The name adopted for this taxon is *Chaenothecopsis viridireagens* (Nádv.) A. F. W. Schmidt (Schmidt, 1970: 153).

Chaenothecopsis viridireagens occurs on wood of coniferous, rarely deciduous trees in shaded habitats. The species is widely distributed in cool and temperate areas of both the Northern and Southern Hemisphere.

xyloxena
Chaenotheca xyloxena Nádv. 1934: 308.
'Böhmen: Hlinsko, im Wald "Horky" bei Pláňavy, 630 m. - Mähren: am Fluss Rokytná bei Budkovce, 210 m, *Salix* (leg. J. Suza). - Slowakei: Sobrance: bei Ruský Hrabovec, 290 m. - Karpathorussland: Anhöhe Černava bei Turja Pasika, 300 m (Eichenholz).'

Type: '*Chaenotheca nudiuscula*, Perečín, in monte Černava pr. pag. T. Pasika, ad lign. *Querc*., 300 m, 23.V.1933' (BRA, lectotype designated by Tibell, 1980: 55).

Chaenotheca xyloxena occurs on wood of coniferous and deciduous trees. It is widely distributed in the cool to temperate zones of both the Northern and Southern Hemisphere (Tibell, 1999, 2002).

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HETEROBASIDIOMYCETES FROM RANCHO GRANDE, VENEZUELA

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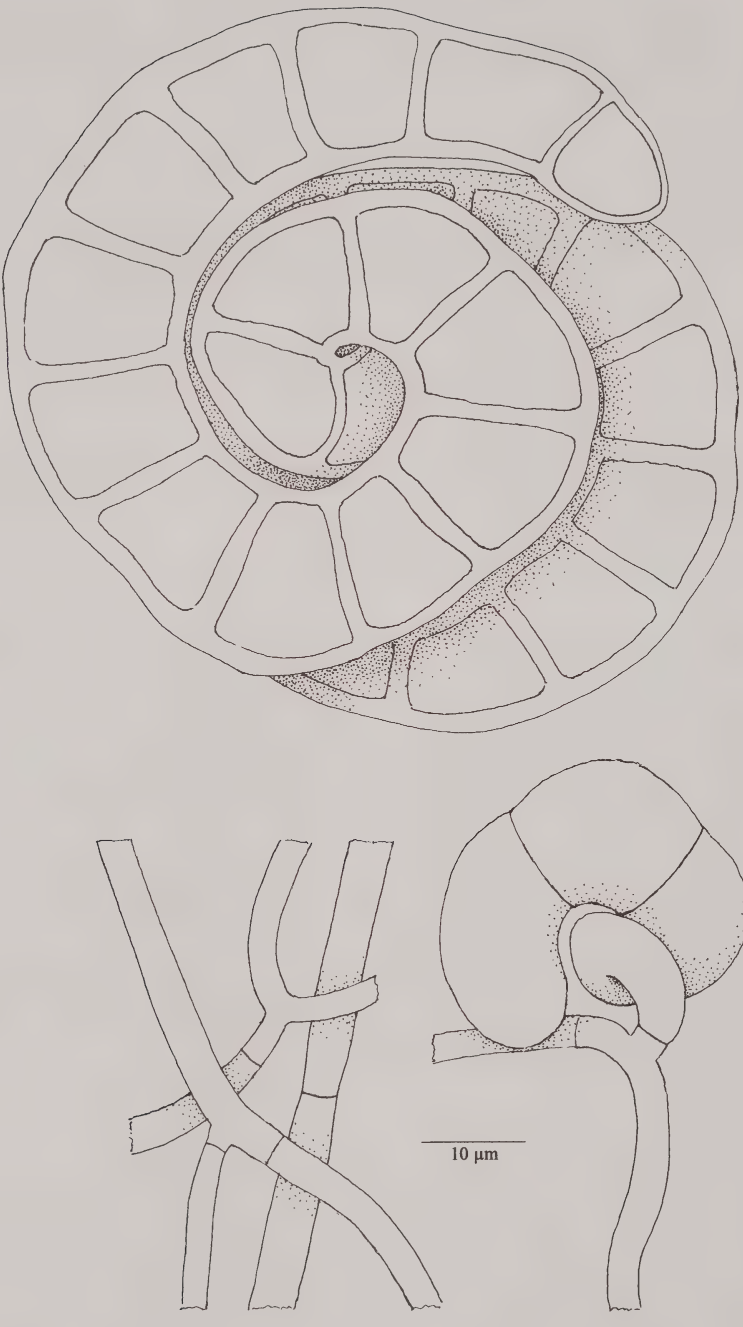
Abstract. Thirty species of heterobasidiomycetous fungi belonging to the orders Atractiellales, Auriculariales, Dacrymycetales, Exidiales, Septobasidiales, and Tremellales are described or reported from the Rancho Grande area of the the Parque Nacional 'Henri Pittier' in Aragua State, Venezuela. *Exidiopsis badia* and *E. endoramifera* are described as new.

Keywords. Atractiellales, Auriculariales, Dacrymycetales, Exidiales, Septobasidiales, Tremellales

Heterobasidiomycetous fungi were collected by the author, other tutors, and students before and during field trips associated with the Tropical Basidiomycetes Workshop (29 – 30th August, 1999) preceding the III Congreso Latinoamericano de Micología held at the Universidad Simón Bolívar, Caracas, Venezuela. These field trips were made in the immediate vicinity of the Rancho Grande field station, situated in submontane cloud forest (1,000 – 1,200 m) within the Parque Nacional 'Henri Pittier' in Aragua State. Details of the climate, ecology, and vegetation of Rancho Grande and the Parque Nacional 'Henri Pittier' were published by Huber (1986). A number of additional collections from the Rancho Grande area are held at Kew and are included in the present paper. These specimens were collected by A.H.G. Alston in 1939, Dr R.W.G. Dennis in 1949, and Prof. L. Ryvarden between 1994 and 2000. Further Venezuelan specimens of species found at Rancho Grande have also been noted, if held at Kew. Amongst these are A. Fendler's collections dating from 1855, which are unlocalized but may be from Aragua State (Dennis, 1970). Also included are a few previous records of heterobasidiomycetes from Rancho Grande and the Parque Nacional 'Henri Pittier' published in Lowy (1971; 1975) and in Páez de Badillo (1982).

Collections of heterobasidiomycetous fungi made during the Tropical Basidiomycete Workshop in 1999 were split into three sets, one retained in the herbarium of the Universidad Simón Bolívar (USB), one in the Herbario Nacional de Venezuela (VEN), and one at the Royal Botanic Gardens, Kew (K). Only the last is noted below.


10 µm

ATRACTIELLALES

Hobsonia mirabilis *(Peck) Linder* in Ann. Missouri Bot. Gard. 16: 340 (1929).
Hobsonia gigaspora Massee in Ann. Bot. 5: 509 (1891). **Fig. 1**

Fruitbodies viscid-gelatinous, soft and deliquescent, pulvinate, 10 – 30 mm diam., smooth, coalescing, hyaline to opalescent whitish. *Hyphae* in a loose gelatinous matrix, 2 – 4.5 µm diam., hyaline, thin-walled, lacking clamp-connexions. *Coiled propagules* arising on short side-branches from hyphae, the individual coils hypha-like, hyaline with granular contents, 10 – 15 µm diam., thick-walled, multi-septate, variously spiralling several times to form a propagule some 50 – 80 µm diam. *Spores* not known.

Specimens Examined: **Venezuela**: unlocalized, on bamboo culm, 1855, *Fendler* 292, (holotype of *Hobsonia gigaspora*) **K(M) 85756**; Aragua, Rancho Grande, Pico Periquito, on palm petiole, 20 Nov. 1949, *Dennis* 250A, **K(M) 85755**; Rancho Grande, on fallen stem, 25 Aug. 1999, *Roberts*, **K(M) 64295**; Distr. Federal, El Avila, on dead bamboo stem, 4 July 1958, *Dennis* 1363, **K(M) 85757**; Miranda, Guatopo, between Ocamare del Tuy & Altagracia de Orituco, on palm debris, 27 June 1958, *Dennis* 1364, **K(M) 85758**.

Hobsonia mirabilis produces viscid, gelatinous, hyaline to whitish fruitbodies on a variety of woody or herbaceous substrata, particularly old, decaying palm fronds. Though easily mistaken for a heterobasidiomycetous fungus in the field, its microscopic characters have led to its being classed as an anamorphic ascomycete, the coiled propagules interpreted as conidia. Recent molecular research (Sikaroodi *et al*., 2001) has suggested, however, that *Hobsonia mirabilis* is related to the genus *Helicogloea* in the Atractiellales.

Hobsonia gigaspora (the type of the genus *Hobsonia* Massee) was described from Venezuela (type specimen cited above), but the species is now considered a synonym of *H. mirabilis* (Martin, 1959).

AURICULARIALES

Auricularia cornea *Ehrenb.*, in Nees von Esenbeck, Horae Phys. Berol.: 91 (1820).
Auricularia polytricha (Mont.) Sacc. in Atti. R. Inst. Veneto VI. 3: 722 (1885), *fide* Wong & Wells (1987).

Specimens Examined: **Venezuela**: unlocalized, 1855, *Fendler* 162 (ex herb. M.J. Berkeley, as '*Stereum exidiaforme*'), **K(M) 83198**; Amazonas, Atures, on dead branch, 1887, *A. Gaillard* 17 (as *Auricularia polytricha*), **K(M) 83199**; Caño Mosquito, on fallen trunk, 21 Feb. 1976, *Colchester* 2225 (as *Auricularia polytricha*), **K(M) 85306**; Aragua, Maracay, on dead trunk, undated, *C. Vogl* (Sydow, Fungi Exotici Exs. 1028, as *Auricularia auricula-judae*), **K(M) 85305**; Rancho Grande, on fallen wood, 29 Aug. 1999, *N. Hallenberg*, **K(M) 64040**.

Auricularia cornea is a common and conspicuous pantropical species, distinguished from similar taxa by its smooth hymenium and hirsute, but unzoned pileus. Lowy (1951, 1952) considered *Auricularia polytricha, A. tenuis*, and *A. cornea* to be distinct species based on the length of the pileal hairs and perceived differences in basidiome structure. However, Wong & Wells (1987)

Fig. 1. (opposite page) **Hobsonia mirabilis**. Coiled propagule; unclamped hyphae; immature propagule still attached to hypha (K(M) 64295).

demonstrated that all three were interfertile and hence synonymous, *A. cornea* being the oldest valid name. The species was previously reported from Venezuela (as *A. polytricha*) by Dennis (1970) and Lowy (1971; 1975).

Auricularia fuscosuccinea *(Mont.) Henn.*, Bot. Jahrb. Syst. 17: 19 (1893).

Specimens Examined: **Venezuela**: Aragua, Rancho Grande, on partly fallen wood, 30 Aug. 1999, *Roberts* V46, **K(M) 64043**; Miranda, Guatopo, 22 June 1958, *Dennis* 1406, **K(M) 78121**.

Originally described from Cuba, *Auricularia fuscosuccinea* is a common species in the neotropics, differing from *A. cornea* (above) in its thinner, often violaceous basidiomes which lack conspicuous hairs on the pileus. The species was previously reported from Venezuela by Dennis (1970) and a specimen from Rancho Grande was listed in Lowy (1971).

Auricularia mesenterica *Pers.*, Mycol. Eur. 1: 97 (1822).

Specimens Examined: **Venezuela**: Aragua, Maracay, on dead trunk, 1933, *C. Vogl* (Sydow, Fungi Exotici Exs. 903), **K(M) 85778 & 85779**; Rancho Grande, on hardwood, 21 Feb. 2000, *Ryvarden* 42260, **K(M) 83201**.

Auricularia mesenterica is a cosmopolitan species distinguished by its effused basidiomes with partial pilei, the pileal surface being zoned and densely pilose. The species is widespread in Central and South America (Lowy, 1971) and has previously been reported from Venezuela by Dennis (1970) and Lowy (1975).

DACRYMYCETALES

Dacrymyces enatus v. **macrosporus** *L.L. Kenn.* in Mycologia 50: 902 (1958).

Specimens Examined: **Panama**: Barro Colorado Island, 23 Aug. 1952, G.W. Martin & A.L. Welden 8662, (isotype) **K(M) 95953**; **Venezuela**: Aragua, Rancho Grande, on fallen *Miconia* trunk, 29 Aug. 1999, *D.J. Lodge* (*Roberts* V35), **K(M) 64214**.

The taxon is distinguished by its small basidiomes, drying almost black, hyphae with clamp-connexions, conspicuous branched hyphidia, and 3-septate basidiospores with slightly thickened walls. The Venezuelan collection agrees well with the varietal type from Panama (cited above). The temperate *Dacrymyces enatus* var. *enatus* has rather smaller, typically 1-septate basidiospores with thin walls. McNabb (1973) reviewed and illustrated the differences between the two taxa, suggesting they might be distinct species, but maintaining them *pro tem* at variety level.

Dacryopinax dennisii *McNabb* in New Zealand J. Bot. 3: 69 (1965).

Specimen Examined: **Venezuela**: Miranda, Sierra Nevada, La Mucuy, on log, 6 Aug. 1958, *Dennis*, (holotype) **K(M) 85781**.

Dacryopinax dennisii was originally described from Venezuela, based on the type specimen cited above, and is distinguished *inter alia* by its small, pendent basidiomes up to 10 mm in length and by its 3-septate basidiospores. The species was reported from the Parque Nacional 'Henri Pittier' by Lowy (1975).

Dacryopinax elegans *(Berk. & M.A. Curtis) G.W. Martin* in Lloydia 11: 116 (1948).

SPECIMEN EXAMINED: **VENEZUELA**: Distrito Federal, Chichiriviche, on log in coffee plantation, 6 June 1958, *Dennis* 1185, **K(M) 85774**.

Dacryopinax elegans was originally described from South Carolina, USA, and is only known from the Americas. It is distinguished *inter alia* by its conspicuous, spathulate, brownish basidiomes up to 50 mm high and by its thick-walled, 3-septate basidiospores. The species was reported from the Parque Nacional 'Henri Pittier' by Lowy (1975).

Dacryopinax spathularia *(Schwein.) G.W. Martin* in Lloydia 11: 116 (1948).

SPECIMENS EXAMINED: **VENEZUELA**: Aragua, Rancho Grande, on rotten wood, 1939, *Alston* 5783a, **K(M) 78205**; Upper Orinoco, Puerto Zamuro, on rotten wood, May 1887, *A. Gaillard* 32 (as *Guepiniopsis fissus*), **K(M) 82300**.

Dacryopinax spathularia is a common, pantropical species distinguished *inter alia* by its conspicuous, orange-yellow, spathulate basidiomes up to 30 mm high and by its thin-walled, single-septate basidiospores. The species was originally described from the southern United States and was recorded from Venezuela by Patouillard &Gaillard (1888) on the basis of the second collection cited above (as *Guepiniopsis fissus*). McNabb (1965) gave details of its extensive synonymy.

EXIDIALES

Basidiodendron fulvum *(Massee) Ginns* in Opera Botanica 61: 54 (1982).

SPECIMENS EXAMINED: **VENEZUELA**: Aragua, Rancho Grande, on wood, 26 Aug. 1999, *Roberts* V16, **K(M) 85318**; same location, 29 Aug. 1999, *K.-H. Larsson* (*Roberts* V23), **K(M) 64070**; same location, 30 Aug. 1999, *K.-H. Larsson* (*Roberts* V56), **K(M) 64086**.

Basidiodendron fulvum, described from the USA, is similar to *B. eyrei* (Wakef.) Luck-Allen but distinguished by its smaller basidia and basidiospores.

Basidiodendron radians *(Rick) P. Roberts* in Kew Bull. 56: 170 (2001).

SPECIMENS EXAMINED: **BRAZIL**: Rio Grande do Sul, São Leopoldo, on wood, 1930, J. Rick 47, (holotype) **K(M) 56863**; **VENEZUELA**: Aragua, Rancho Grande, on fallen wood, 29 Aug. 1999, *K.-H. Larsson* (*Roberts* V34), **K(M) 64074**; same location, 30 Aug. 1999, *K.-H. Larsson* (*Roberts* V49), **K(M) 64073**; Bolivar, Sifontes, Maderero de Lut, Tumerermo-Bochinche Camp, on deciduous wood, 17 Dec. 1994, *Ryvarden* 35158, **K(M) 34372**.

Basidiodendron radians is a cosmopolitan species, originally described from Brazil (type specimen cited above). It is similar to *B. cinereum* (Bres.) Luck-Allen, but has shorter, ellipsoid basidiospores.

The specimens K(M) 64073 and K(M) 34372 are atypical in having compact basidiomes containing abundant mineral matter, some of which forms irregular tubercules on the hymenial surface. Though microscopically similar to *B. radians*, it is possible that these collections represent a distinct taxon.

Basidiodendron spinosum (*L.S. Olive*) *Wojewoda*, Mała Flora Grzybów II: 91 (1981).

Specimen Examined: **Venezuela**: Aragua, Rancho Grande, on fallen wood, 25 Aug. 1999, *Roberts* V8, **K(M) 77923**.

Basidiodendron spinosum is a cosmopolitan species, originally described from Tahiti and recognized microscopically by its distinctly warted basidiospores. It has been redescribed and illustrated from Costa Rica by Kisimova-Horovitz *et al.* (1997).

Ductifera pululahuana *(Pat.) Donk* in Taxon 7: 164 (1958).

Basidiomes gelatinous, pulvinate to discoid, 0.5 – 3 mm diam., smooth, coalescing, white when fresh, drying olivaceous-ochraceous, tawny-orange when rehydrated. *Hyphae* in a gelatinous matrix, 1.5 – 3 µm diam., hyaline, thin-walled, with clamp-connexions. *Hyphidia* hyaline, thin-walled, strongly branching, former a layer above the basidia. *Gloeocystidia* abundant, conspicuous, up to 160 µm long, tawny in KOH. *Basidia* 4-celled, subglobose to ellipsoid, 12 – 15 x 10 – 12 µm. *Sterigmata* elongated, sinuous. *Basidiospores* cylindrical (Q = 2.0 – 2.4), 9 – 11 x 4.5 – 5 µm, weakly depressed or constricted at mid-point.

Specimens Examined: **Venezuela**: unlocalized, 1855, *Fendler* 212 (ex herb. M.J. Berkeley, filed as *Exidia albida*), **K(M) 35784**; Aragua, Parque Nacional 'Henri Pittier', on hardwood, 25 Apr. 1998, *Ryvarden* 40770, **K(M) 82970**; Rancho Grande, on fallen branch, 30 Aug. 1999, *Roberts* V37, **K(M) 64083**.

Ductifera pululahuana was originally described from Ecuador and previously reported from Venezuela, including the Parque Nacional 'Henri Pittier', by Lowy (1975), as well as from Argentina, Brazil, Chile, Colombia, and Uruguay (Wells, 1957, 1958; Lowy, 1971). The species is recognizable by its small, white, coalescing, pulvinate basidiomes containing long, conspicuous gloeocystidia. Additional synonyms were discussed in Wells (1957). The Fendler collection was originally listed as '*Tremella* - doubtful' (Curtis in Fidalgo & Fidalgo, 1967).

Exidia japonica *Lloyd*, Mycol. Not. 5: 599 (1916).

Specimen Examined: **Venezuela**: Aragua, Rancho Grande, on wood, 29 Aug. 1999, *M. Rajchenberg* (*Roberts* V30), **K(M) 64068**.

Exidia japonica is characterized by its greyish, gelatinous basidiomes with small, whitish to brownish hyphal pegs. These basidiomes are initially discrete and pustular, coalescing and becoming applanate-lobate, then widely but irregularly effused. The species was originally reported from Japan and redescribed by Roberts & Spooner (1998) and Roberts (2001), based on specimens from Africa, Asia, and Australasia. The Venezuelan specimen appears indistinguishable from and probably conspecific with these collections. Macroscopically, it has an initially pustular then coalescing, greyish-hyaline basidiome densely covered in white hyphal pegs. Microscopically, it has a highly gelatinized context, weakly allantoid basidiospores measuring up to 12.5 x 5 µm, and mineral matter frequently coating hyphal ends, especially in the pegs.

Exidia lutea *Lowy* in J. Elisha Mitchell Soc. 80: 66 (1964).

Exidia lutea is a neotropical species, originally described from Guatemala. It was reported from the Parque Nacional 'Henri Pittier' by Lowy (1975).

Exidia nucleata *(Schwein.) Burt* in Ann. Missouri Bot. Gard. 8: 371 (1921).

Exidia nucleata is a cosmopolitan species, originally described from the USA. It was reported from the Parque Nacional 'Henri Pittier' by Lowy (1975).

Exidiopsis badia *P. Roberts* **sp. nov.** **Fig. 2**

Basidiomata effusa, laevia, gelatinosa, brunnea vel erythro-brunnea (badia). *Hyphae* hyalinae, in matrice gelatinosa, 1.5 – 2 µm latae, tenuitunicatae, fibulatae. *Hyphidia* dendroidea, aliquando inflata. *Cystidia* usque ad 100 µm longa, acuta, hyalina vel pallidobrunnea. *Basidia* septata, subglobosa, 13 – 15 x 12 – 13 µm. *Basidiosporae* cylindraceae, 13 – 15 x 5.5 – 6 µm, allantoideae.

HOLOTYPE: VENEZUELA: Aragua, Rancho Grande, on fallen wood, 30 Aug. 1999, *K.-H. Larsson* (*Roberts* V55), **K(M) 64085**; isotypes at VEN and USB.

Basidiomes effused, smooth, gelatinous, dark translucent brown to maroon (dark bay colour), drying a similar colour with a feint pruina in patches, without distinct borders. *Hyphae* hyaline, in a dense but easily squashed gelatinous matrix, 1.5 – 2 µm wide, thin-walled, with clamp-connexions. *Hyphidia* forming a layer above the basidia, typically branched and nodulose, sometimes swollen and weakly moniliform. *Cystidia* up to 100 µm long, not or barely projecting, mostly fusiform with acute or subacute apex, often long-stemmed and possibly arising at modified hyphal ends, hyaline to pale brown in KOH. *Basidia* subglobose, 13 – 15 x 12 – 13 µm, clamped at base, not stalked. *Basidiospores* cylindrical, 13 – 15 x 5.5 – 6 µm, allantoid.

	Hyphae (µm)	Cystidia (µm)	Basidia (µm)	Spores (µm)
D.P. Rogers (1935)	2 - 3	25 – 40 x 6 - 9	15 x 9 - 10	10.5 – 13 x 4.5 - 5
J.M. McGuire (1941)	2 - 3	25 – 50 x 6 - 10	12 – 15 x 8 - 10	10 – 13 x 4 - 5
K. Wells (annot'n)	n/a	24 – 81 x 3 - 16	13 – 16 x 9 – 10.5	10.5 – 12.5 x 4 – 4.5
P. Roberts (annot'n)	2 - 4	up to 50	16 x 10	none seen
Exidiopsis badia	1.5 - 2	up to 100	13 – 15 x 12 - 13	13 – 15 x 5.5 - 6

Table 1: Measurements of elements in *Exidiopsis umbrina* (all based on the US type specimen) compared to *Exidiopsis badia*.

Exidiopsis badia is distinguished macroscopically by its effused, gelatinous, dark reddish-brown basidiomes and micoscopically by its subglobose, unstalked basidia and conspicuous fusiform cystidia with hyaline to pale brown contents.

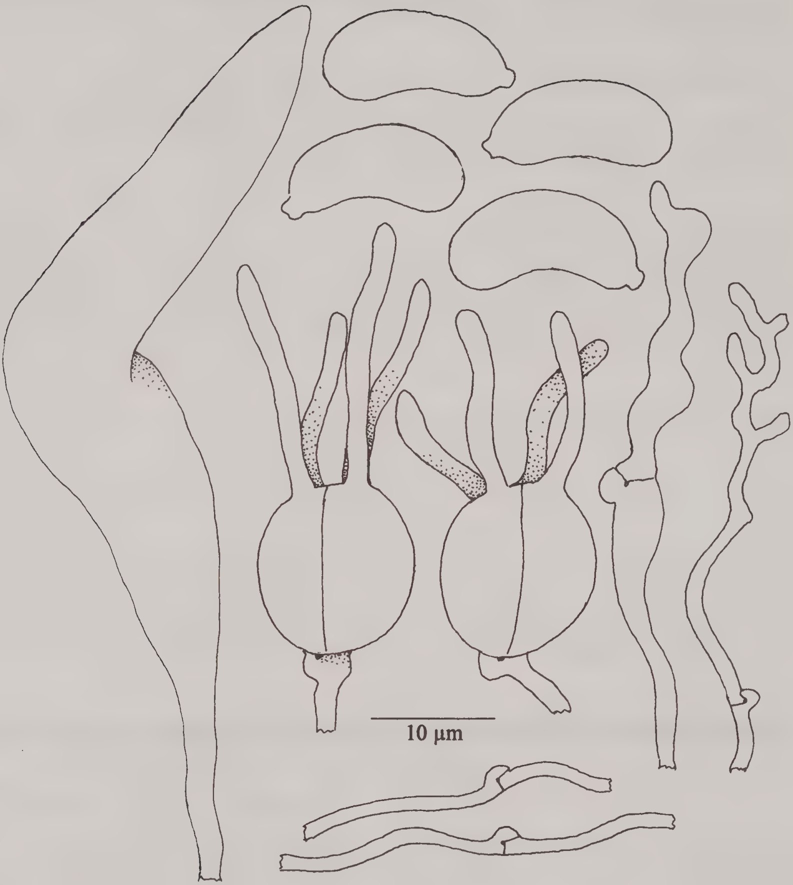


Fig. 2. **Exidiopsis badia**. Basidiospores; cystidium; basidia; hyphidia; hyphae (holotype).

The gloeocystidiate *Exidiopsis umbrina* (D.P. Rogers) Wojewoda, described from North America, is similar, but appears to have wider hyphae, narrower, less globose basidia, and shorter basidiospores, based on published descriptions (see Table 1) and on a re-examination of the type specimen (USA: Iowa, West Okoboji, on *Fraxinus* bark, 9 Aug. 1933, D.P. Rogers 278, IA 368063). The gloeocystidia of *Exidiopsis umbrina* were originally noted as colourless (Rogers, 1935), later as hyaline to pale yellow (McGuire, 1941), still later as pale brown (re-examined in 5% KOH by the present author).

The cosmopolitan species, *Exidiopsis galzinii* (Bres.) Killerm., also has an effused gelatinous basidiome and prominent cystidia, but is distinguished *inter alia* by its its stalked (myxarioid) basidia.

Exidiopsis endoramifera *P. Roberts* **sp. nov.** **Fig. 3**

Basidiomata effusa, laevia, farinosa, tenuia, pallide bubalina. *Hyphae* inconspicuae, hyalinae, 1.5 – 2 µm latae, tenuitunicatae, fibulatae, in matrice crystallina. *Hyphidia* persubtiliter atque dense dendroidea, ramulifera. *Basidia* 4-septata, ellipsoidea, c. 11 x 9 µm. *Basidiosporae* cylindraceae, 10 – 11.5 x 4 – 5 µm, allantoideae.

HOLOTYPE: **VENEZUELA**: Aragua, Rancho Grande, on dead, woody-fibrous material (palm remains?), 29 Aug. 1999, *K.-H. Larsson* (*Roberts* V24), **K(M) 64087**; isotypes at VEN and USB.

Basidiomes effused, smooth, farinose to finely granular under lens, thin, pale buff, with indistinct margins. *Hyphae* difficult to see, but thin-walled, hyaline basal hyphae, 1.5 – 2 µm wide, are present. The hymenial matrix is made up of large mineral masses plus finely branched hyphidia-like hyphae. *Hyphidia* densely and very finely branched, present throughout the hymenium, staining in lactophenol cotton-blue. *Cystidia* absent. *Basidia* 4-septate, ellipsoid, c. 11 x 9 µm. *Basidiospores* cylindrical, 10 – 11.5 x 4 – 5 µm, allantoid.

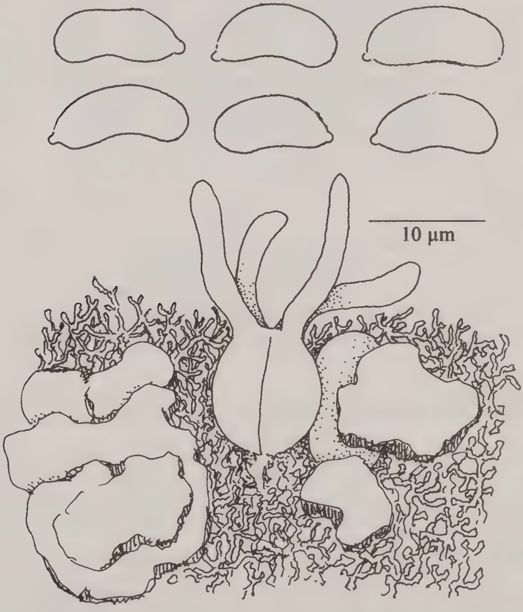


Fig. 3. **Exidiopsis endoramifera**. Basidiospores; section of hymenium showing basidia, hyphidia-like hyphae, and clumps of mineral matter (holotype).

Exidiopsis endoramifera superficially resembles a species of *Basidiodendron*, having thin, effused, pale buff basidiomes with indeterminate margins. Microscopically, however, it lacks gloeocystidia and has an unusual structure composed of large mineral masses in a context of finely branched hyphidia-like elements (Fig. 3). These elements form a rather amorphous mass and are only seen clearly because they stain in lactophenol cotton-blue. Basidia emerge from this amorphous context as if arising from a catahymenium. The basidiospores are suballantoid to allantoid, typical for *Exidiopsis* species.

The peculiar structure of *Exidiopsis endoramifera* is similar to that found in some species of the holobasidiomycetous genus *Vararia* which form a catahymenium of very finely branched hyphal elements from which basidia emerge when sporulating conditions are right. Such a hymenium does not appear to have been observed in heterobasidiomycetes before, though it is one of several possible adaptations to growing in exposed conditions on standing wood. Other adaptations include a gelatinous basidiome (as in *Exidiopsis badia*, above), a mineralized basidiome (partly present in *E. endoramifera*), and a coriaceous basidiome (as in *Eichleriella* species). All are presumed to maintain and extend the lifespan of basidiomes in dry weather, allowing rapid spore production at the onset of rain.

Exidiopsis mucedinea *(Pat.) K. Wells* in Lloydia 20: 46 (1957). **Fig. 4**

Basidiomes effused, smooth, farinose to mucedinoid under lens, thin, white tinged pale buff in places, with indistinct margins. *Hyphae* easily seen, 2 – 4 µm wide, hyaline, with thin to slightly gelatinized walls, basal hyphae forming agglutinated sheets, clamp-connexions present and conspicuous. The matrix contains copious fine to granular mineral matter. *Hyphidia* not conspicuous in the specimen examined, consisting of simple or nodular elements, sometimes swollen. *Cystidia* absent. *Basidia* 4-septate, ellipsoid, 13 - 14 x 9 - 11 µm. *Basidiospores* cylindrical, 9 - 13.5 x 4 – 5.5 µm, allantoid.

SPECIMEN EXAMINED: **VENEZUELA**: Aragua, Rancho Grande, on twig, 24 Nov. 1994, *Ryvarden* 35506, **K(M) 85297**.

Exidiopsis mucedinea is distinguished by its rather thin, whitish basidiomes, abundant mineral granules in the hymenium, and comparatively small, allantoid basidiospores. It appears rather similar to the European *E. calcea* (Pers.) K. Wells, but the latter differs *inter alia* in its larger basidia and basidiospores. The species was originally described from Ecuador and has also been reported from Panama and Brazil. There is additional material at K from Argentina.

Heterochaete cystidiophora *(Lowy) Oberw. et al.* in Rev. Biol. Trop. 45: 1331 (1997).

SPECIMENS EXAMINED: **BRAZIL**: Est. Santa Catarina, Morro de Bau, 22 Aug. 1965, B. Lowy 181 BR, (holotype) **LSUM SP 92404**; **VENEZUELA**: Aragua, Rancho Grande, on wood, 30 Aug. 1999, *K.-H. Larsson* (*Roberts* V40), **K(M) 64076**; same location and date, on partly fallen branch, *Roberts* V44, **K(M) 64079**; same location and date, on wood, *N. Hallenberg* (*Roberts* V48), **K(M) 64080**.

Heterochaete cystidiophora is immediately recognizable microscopically by its prominent hyphal pegs which, under a lens, are substantially composed of thick-walled, encrusted cystidia. The species was originally described from Brazil and was previously recorded from Venezuela by Lowy (1975). It has also been recorded and illustrated from Costa Rica (Kisimova-Horovitz *et al.*, 1997).

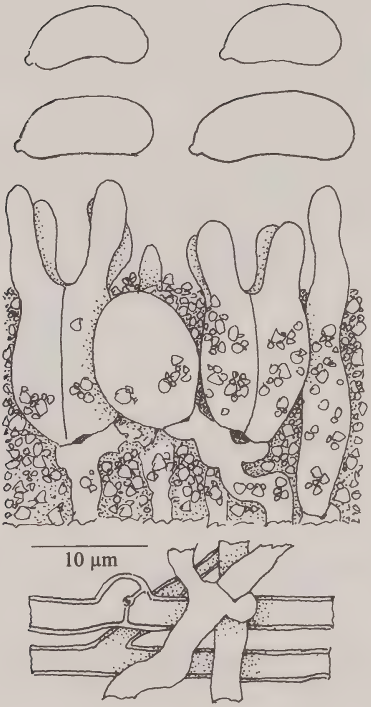


Fig. 4. **Exidiopsis mucedinea**. Basidiospores; section of hymenium showing basidia, simple hyphidium, and granular mineral matter; hyphae (K(M) 85297).

Heterochaete sanctaecatherinae *Möller* in Bot. Mitth. Trop. 8: 81 (1895). **Fig. 5**

Basidiomes effused, thin, subceraceous, closely attached, margins indistinct sometimes turning into thin, sterile hyphal fans, off-white to cream, pale buff in places, irregularly covered (under lens) with small, concolorous, tubular hyphal pegs, c. 4 - 6 per mm. *Hymenium* compact, comprising a dense layer of basidia and broad, irregular, cystidia-like hyphidia which disintegrate to produce fine, omnipresent granular matter, obscuring the hyphae. *Hyphae* narrow, 1.5 - 2 μm diam., highly agglutinated and difficult to see (except at the margins), hyaline, thin-walled, with sparse clamp-connexions. *Hyphal pegs* arising from the hymenium, projecting 90 - 120 μm from the surface, +/- tubular, c. 40 μm wide, composed of densely agglutinated hyphae and fine granular matter. *Hyphidia* irregularly swollen, 30 – 40 x 4 – 6 μm, nodulose or weakly branched, the apices disintegrating into fine, hyaline granules. *Cystidia* none seen, though the hyphidia are cystidia-like. *Basidia* 4-celled, ellipsoid (Q = 1.5), c. 15 x 10 μm. *Sterigmata* four, becoming sinuous and elongated. *Basidiospores* cylindrical, allantoid (Q = 3.0 – 3.2), 13.5 - 16 x 4.5 - 5 μm, smooth, hyaline.

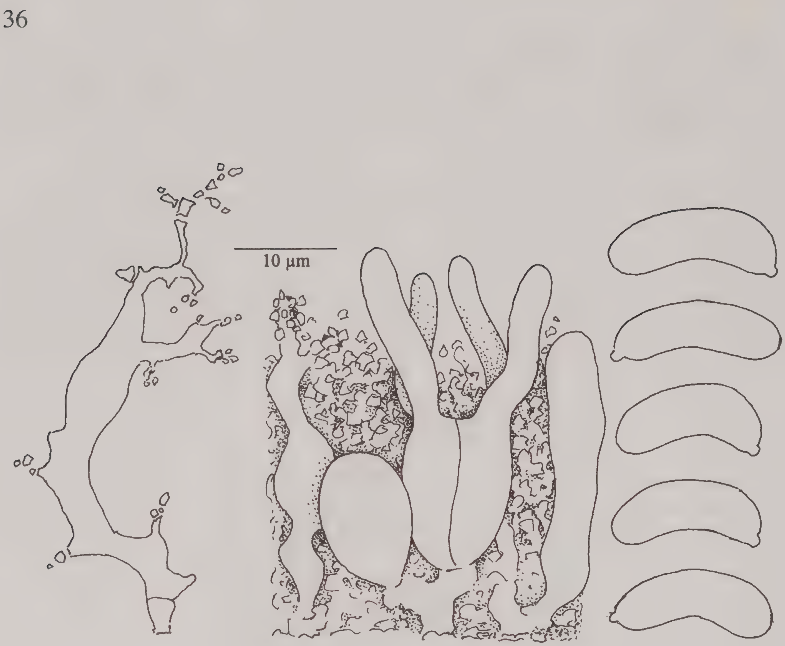


Fig. 5. **Heterochaete sanctaecatherinae**. Irregularly branched hyphidium; section of hymenium showing hyphidia, basidia, and granular mineral matter; basidiospores (K(M) 64075).

SPECIMENS EXAMINED: **VENEZUELA**: Aragua, Rancho Grande, on stick, 24 Nov. 1994, *Ryvarden* 35550, **K(M) 85292**; same location, on wood, 26 Aug. 1999, *K-H. Larsson* (*Roberts* V25), **K(M) 64075**.

The specimens cited above are distinguished by their thin, effused, closely adnate basidiomes which have indeterminate margins, are whitish to cream, and macroscopically resemble species of the corticioid genus *Hyphodontia* J. Erikss. Microscopically the basidia are 4-spored, the hyphidia swollen and producing copious granular matter, the hyphae narrow and hyaline, and the basidospores comparatively large and distinctly allantoid.

These features correspond to *Heterochaete sanctaecatherinae sensu* Bodman (1952), but the original type description and illustration of the species from Brazil (Möller, 1895) suggest that elements in the hyphal pegs are cystidia-like, projecting, and conspicuous (i.e. similar to those seen in *H. cystidiophora*, above). Such cystidia were not observed in the Venezuelan specimen. *Heterochaete sanctaecatherinae sensu* Bodman has previously been reported from Rancho Grande by Páez de Badillo (1982). There is additional South American material at K from Argentina and the species is also known from the Caribbean (Lowy, 1971).

Heterochaete sanctaemartae *Bodman* in Lloydia 15: 226 (1952). **Fig. 6**

Basidiomes effused, thin, ceraceous to gelatinous, closely attached, margins indistinct, hyaline-pinkish, drying to a thin, pinkish film, irregularly covered (under lens) with small, irregular, concolorous, tubular hyphal pegs, c. 10 - 12 per mm. *Hymenium* compact, agglutinated. *Hyphae* narrow, 1.5 – 2.5 µm diam., agglutinated, hyaline, with refractive walls, with clamp-connexions.

Hyphal pegs arising from the hymenium, projecting 60 - 70 µm from the surface, +/- tubular, c. 25 µm wide, composed of densely agglutinated hyphae and clumps of mineral matter. *Hyphidia* branched, hyaline, not clearly seen. *Cystidia* none seen. *Basidia* 4-celled, ellipsoid (Q = 1.5), c. 15 x 10 µm. *Sterigmata* four. *Basidiospores* cylindrical, weakly allantoid (Q = 1.8 – 2.2), 10 - 11 x 4.5 – 5 (- 6) µm, smooth, hyaline.

SPECIMEN EXAMINED: **VENEZUELA**: Aragua, Rancho Grande, on wood, 30 Aug.. 1999, *Roberts* V47, **K(M) 77922**.

The specimen was mistaken for a species of the corticioid genus *Resinicium* Parmasto in the field, having a similar colour and thin, ceraceous-gelatinous texture. The small hyphal pegs are only visible under a lens, densely and irregularly dotted over the surface. Microscopically it is clearly a species of *Heterochaeate*, belonging to the minority of taxa which are gelatinized. Following Bodman (1952), it keys out quite straightforwardly to *H. sanctaemartae*, described from Colombia and reported in Lowy (1971) from Cuba and Brazil.

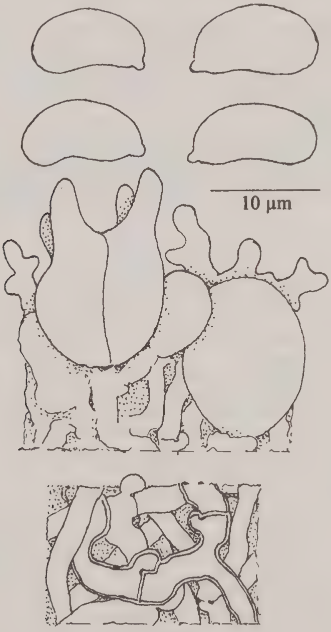


Fig. 6. **Heterochaete sanctaemartae**. Basidiospores; section of hymenium showing hyphidia and basidia; agglutinated hyphae (K(M) 77922).

Heterochaete shearii (*Burt*) *Burt* in Ann. Missouri Bot. Gard. 8: 377 (1921).

SPECIMENS EXAMINED: **VENEZUELA**: Aragua, Parque Nacional 'Henri Pittier', on wood, 25 Apr. 1998, *Ryvarden* 40831, **K(M) 85293**; Rancho Grande, on partly fallen stick, 26 Aug. 1999, *Roberts* V17, **K(M) 64046**; same location, on partly fallen wood, 29 Aug. 1999, *Roberts* V26,

K(M) 64041; Bolivar, Sifontes, Maderero de Lut, Tumerermo-Bochinche Camp, on deciduous wood, 17 Dec. 1994, *Ryvarden* 35135, **K(M) 34371**.

Heterochaete shearii can be distinguished macroscopically by its effused, greyish-brown basidiomes, bruising brown, with abundant but irregular, tubular hyphal pegs, and microscopically by its brown subicular hyphae, abundant cystidia-like elements in the hymenium, and consistently bisterigmate basidia (illustrated in Roberts, 2001). The species was particularly common at Rancho Grande in August 1999, such that only a sample of the specimens seen was collected and recorded.

Heterochaete shearii was first described from the USA and has been widely recorded in the Caribbean, Central, and South America, Africa, Asia, and southern Europe. It was previously recorded from Rancho Grande by Páez de Badillo (1982) and there is additional South American material at K from Argentina and Brazil.

Oliveonia fibrillosa *(Burt) Donk* in Fungus 28: 20 (1958).

SPECIMENS EXAMINED: **VENEZUELA**: Aragua, Rancho Grande, on wood, 30 Aug. 1999, *K-H. Larsson* (*Roberts* V45), **K(M) 85304**; Bolivar, Sifontes, Maderero de Lut, Tumerermo-Bochinche Camp, on old fruitbody of the polypore *Nigrofomes melanosporus*, 17 Dec. 1994, *Ryvarden* 35119, **K(M) 35287**.

Oliveonia fibrillosa is a thin, holobasidiomycetous, corticioid fungus with replicating basidiospores, provisionally placed within the Exidiales (redescribed and illustrated in Roberts, 1998a). The type of *O. fibrillosa* was collected in Mexico and the Venezuelan specimens appear conspecific.

Stypella dubia (*Bourdot & Galzin*) *P. Roberts* in Mycotaxon 69: 216 (1998).

SPECIMEN EXAMINED: **VENEZUELA**: Aragua, Rancho Grande, on rotten wood, 29 Aug. 1999, *K-H. Larsson* (*Roberts* V28), **K(M) 64089**.

Stypella dubia is a cosmopolitan species, originally described from France and redescribed and illustrated in Roberts (1998b). It is distinguished *inter alia* by its fascicles of thick-walled cystidia. It has previously been reported in South America from Brazil (Lowy, 1971, as *Heterochaetella dubia*).

Stypella grilletii (*Boudier*) *P. Roberts* in Mycotaxon 69: 223 (1998).

SPECIMENS EXAMINED: **VENEZUELA**: Aragua, Rancho Grande, on fallen stick, 26 Aug. 1999, *Roberts* V15, **K(M) 64213**; same location, on fallen wood, 30 Aug. 1999, *Roberts* V38, **K(M) 64088**; same details, *Roberts* V50, **K(M) 64059**; same details, *Roberts* V53, **K(M) 64057**.

Stypella grilletii is a common, worldwide species, originally described from France and redescribed and illustrated in Roberts (1998b). It has previously been recorded from Venezuela (as *Exidiopsis podlachica* (Bres.) Ervin) by Lowy (1975) and it is probable that additional records for Venezuela, Columbia, and Brazil published under the dubious name *Stypella minor* Möll. (Lowy, 1971; 1975) also refer to this species. *Stypella grilletii* is known with certainty from Central America and the Caribbean.

Stypella subhyalina (*A. Pearson*) *P. Roberts* in Mycotaxon 69: 234 (1998).

SPECIMENS EXAMINED: **VENEZUELA**: Aragua, Rancho Grande, on wood, 14 April 1999, *Ryvarden* 41432, **K(M) 83203**; same location, on fallen rotten wood, 29 Aug. 1999, *Roberts* V29, **K(M) 64066**.

Originally described from England, *Stypella subhyalina* is distinguished by its thin-walled cystidia, typically fusiform with an acute apex, though in the second Rancho Grande specimen some are tubular and obtuse or even rostrate. The species was described and illustrated in Roberts (1998b). *Stypella subhyalina* does not appear to have been recorded from South America before, though it is known from North America.

SEPTOBASIDIALES

Septobasidium septobasidioides *(Henn.) Lloyd*, Mycol. Notes 5: 722 (1917).

SPECIMEN EXAMINED: **VENEZUELA**: Aragua, Rancho Grande, on wood, 14 Apr. 1999, *Ryvarden* 41313, **K(M) 85299**.

This species, associated with scale insects, is distinguished by its smooth, papery, pale violaceous-buff hymenium, a dark brown context consisting of 'pillars' of agglutinated hyphae, and a thin brown subiculum. Basidia are 4-celled and lack a persistent probasidium. It was originally described from Brazil and well illustrated by Couch (1938) from Jamaica. The new Venezuelan collection is similar to Couch's Jamaican material held at K.

TREMELLALES

Tremella aurantia *Schwein.*, Schrift. Nat. Ges. Leipzig 1: 114 (1822).
Tremella mellea Lloyd, Mycol. Writ. 5: 818 (1919).

SPECIMENS EXAMINED: **CHILE**: Santiago, undated, M.R. Espinosa (C.G. Lloyd 4008), (holotype of *Tremella mellea*) **BPI 702287**; **VENEZUELA**: Aragua, Rancho Grande, on fallen branch, 29 Aug. 1999, *Roberts* V43, **K(M) 64084**.

Tremella aurantia is a yellowish, lobed to foliaceous species described and illustrated in Roberts (1995). It is a parasite of *Stereum* species, having conspicuous, unclamped host hyphae in the basidiome context. The species was originally described from the USA and has previously been collected in Brazil (Roberts & de Meijer, 1997). The type of *Tremella mellea* from Chile (cited above) has been re-examined and appears to be the same species.

Tremella foliacea *Pers.*, Obs. 2: 98 (1799).

Basidiomes gelatinous, foliaceous, dark watery brown when soaked. *Hyphae* hyaline, 2 - 4 μm diam., thin-walled, with clamp-connexions. *Haustorial cells* not seen. *Conidiophores* not seen. *Conidia* (yeast cells) mostly ovoid-oblong, 3.5 – 5 x 2.5 – 3.5 μm. *Basidia* 4-celled, subglobose to ellipsoid (but many irregular), 11 - 14 x 10 μm, unstalked. *Basidiospores* ellipsoid (Q = 1.3 - 1.4), 6.5 - 8 x 5 - 6 μm, germinating by yeast cells.

SPECIMEN EXAMINED: **VENEZUELA**: Aragua, Rancho Grande, on sticks, 19 Nov. 1949, *Dennis* 216a, **K(M) 76507**.

The Rancho Grande collection appears macroscopically and microscopically close to European material (described and illustrated in Roberts 1999) and material from Brazil (described and illustrated in Roberts & de Meijer 1997). *Tremella foliacea* was originally described from Europe and appears to be cosmopolitan. It was previously recorded from Venezuela by Lowy (1975) who placed the species in synonymy with *Tremella fimbriata* Pers., now considered a *nomen dubium*. His reports of *T. fimbriata* from Colombia and Central America (Lowy 1971; 1975) require re-examination.

Tremella olens *Berk.* in Hooker, Fl. Tasm. II: 262 (1860).

Basidiomes gelatinous, pustular to irregularly lobed, hyaline to whitish opalescent. *Hyphae* hyaline, 3 - 6 µm diam., most with thick, gelatinized walls both in context and hymenium, a few thin-walled; clamp-connexions present and conspicuous, often open and loop-like. *Haustorial cells* not seen. *Conidiophores* not seen. *Conidia* (yeast cells) ovoid, 2 – 5.5 x 1.5 - 4 µm, arising from germinating basidiospores. *Basidia* 4-celled, ellipsoid, 15 - 16 x 12 - 14 µm, unstalked. *Sterigmata* elongated, sinuous. *Basidiospores* (few seen) ellipsoid (Q = 1.2 – 1.3), 7 - 8.5 x 5.5 - 7 µm, germinating by yeast cells.

SPECIMENS EXAMINED: VENEZUELA: Aragua, Rancho Grande, on fallen branch, 25 Aug. 1999, *Roberts* V11, **K(M) 64288**; Bolivar, Gran Sabana, St Helena, on hardwood, 21 Nov. 1994, *Ryvarden* 35375, **K(M) 83152**.

Tremella olens is distinguished by its pustular to lobed, hyaline to whitish basidiomes, thick-walled, gelatinized hyphae, and ellipsoid basidiospores. The Rancho Grande collection was mistaken for watery *Dacrymyces* specimens in the field. The species was reviewed in Roberts (2001) based on African and Asian material together with the Australian type collection. *Tremella fibulifera* Möll., described from Brazil, has thin-walled hyphae in the hymenium, but is otherwise very similar, based on a redescription of the type specimen (Bandoni & Oberwinkler, 1983) and more recent Brazilian collections (Roberts & de Meijer, 1997). If the two species should prove to be conspecific, *Tremella olens* is the older name.

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PROPOLIS AND MARTHAMYCES GEN. NOV. (RHYTISMATALES)

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ABSTRACT

The genus *Propolis* is briefly reviewed with a short description. All taxa described in the genus are listed with a critical annotation. *Marthamyces* gen. nov. (*Rhytismataceae*, *Rhytismatales*), is erected to accommodate taxa with filiform ascospores placed in *Propolis* (Fr.) Corda, mostly in recent years, and not congeneric with the type species *P. farinosus*, as follows: *Marthamyces dendrobii*, *M. desmoschoeni*, *M. dracophylli*, *M. emarginatus*, *M. foliicola*, *M. panizzei*, *M. phacidioides*, *M. quadrifidus*, *M. quercifolius* combs. nov.

Key words: ascomycetes, *Rhytismataceae*

Introduction

There has been a long history of problems with the names *Propolis* and *Propolomyces* (Sherwood 1977*b*; Dennis 1981), leading to a proposal by Holm *et al.* (1986) to conserve *Propolis* Fr. (1849) against *Propolis* (Fr.) Corda (1838). The Committee for Fungi and Lichens rejected this proposal (Gams 1992) on the grounds that it was unnecessary. As a result, *Propolomyces* Sherwood is an illegitimate name (Gams 1992; Eriksson & Hawksworth 1992) and a synonym of *Propolis* (Fr.) Corda, since the types of both genera (*Propolomyces farinosus* (Pers.) Sherwood and *Propolis versicolor* (Fr.) Fr. respectively) refer to the same fungus.

Propolis (Fr.) Corda can now be used in the traditional sense for wood-inhabiting ascomycetes producing deeply embedded apothecia with little or no blackened upper wall, but with aseptate, often kidney-shaped ascospores. These ascomycetes belong in the *Rhytismatales* fam. indet. Other, generally leaf-inhabiting species also with little or no blackened upper wall, but with long thin septate ascospores, placed in *Propolis*, mostly in recent years (Sherwood 1977*b*; Johnston 1986; Johnston 1991, Nograsek & Matzer 1994), but clearly not congeneric with the type of *Propolis* need to be relocated to a genus in the *Rhytismataceae*.

There are already two genera of the *Rhytismataceae* with these characters: *Naemacyclus* Fuckel and *Cyclaneusma* DiCosmo, Peredo & Minter (DiCosmo *et al.* 1983). The type of *Naemacyclus*, *N. pinastri* (Desm.) Fuckel [= *N. fimbriatus* (Schwein.) DiCosmo, Peredo & Minter] fruits as a saprobe on dead needles and cones of *Pinus* and has ascomata externally very similar to those of *Stictis* Pers., with long hair-like cells produced from the upper wall and lining the split. The type of *Cyclaneusma*, *C. minus* (Butin) DiCosmo, Peredo & Minter fruits as a saprobe on dead needles of *Pinus*, and has ascomata opening by characteristic twin flaps, and rather characteristic 2-septate, boomerang-shaped ascospores. Neither is an appropriate genus to accommodate the fungi formerly placed in *Propolis*.

The present paper attempts to deal with the problem by describing a new genus. It also provides a critically annotated list of all taxa described in *Propolis*. Although type material of some newly recombined names has not been examined during this study, in all cases that type material has been examined, described and often illustrated in systematic works of good quality in the last twenty years (Sherwood 1977*b*; Johnston 1986, 1991; Nograsek & Matzer 1994). Unless otherwise indicated, synonymy is based on the works of Rehm (1888), Sherwood (1977*a*, 1977*b*) and personal research. Where a *listed name* is cross-referenced to an **accepted name** also treated in the present paper, information about the place of publication is provided only in the synonymy list under the **accepted name**.

PROPOLIS (Fr.) Corda, *Icones Fungorum hucusque Cognitorum* **2**: 38 (1838). [*Rhytismatales*, *Rhytismataceae*]
Stictis subgenus *Propolis* Fr., *Systema Mycologicum* **2** (1): 198 (1822).
Propolomyces Sherwood, *Mycotaxon* **5**: 321 (1977).

Type: *Propolis versicolor* (Fr.) Fr. [*fide* Holm *et al.* (1986: 599)] [= *P. farinosa* (Pers.) Fr.]

Description. *Habit*: saprobic, usually on wood, bark, fallen conifer cones and similar substrata. *Ascomata*: apothecial, circular or angular, frequently coalescing, immersed, with little or no lower, side or upper walls, without a covering layer or with one which is mostly very soon lost, with a rather thin subhymenium, and a whitish or coloured hymenial surface. *Asci*: saccate, with one functional wall layer, maturing sequentially, generally not bluing in iodine, opening by an apical hole or crack, usually 8-spored, with ascospores arranged biseriately or in a cluster. *Ascospores*: colourless or slightly pigmented, ellipsoid to reniform, thin-walled, smooth, aseptate or sometimes transversely septate. *Paraphyses*: slender, thin-walled, smooth, aseptate or septate, often branched or flexuous at the tips. *Conidial state*: not observed.

Notes. *Propolomyces* Sherwood is typified by *P. farinosus* (Pers.) Sherwood. The two generic names are therefore taxonomic rather than nomenclatural synonyms.

Propolis alba (DC.) Fr.
Propolis farinosa (Pers.) Fr.

Propolis angulosa P. Karst.

Notes. The place of publication of this name has not been traced. The source of the information is: Cash (1953) p. 15.

Propolis betulae Fuckel
Propolis farinosa (Pers.) Fr.

Propolis betulae var. *callunae* E. Bommer & M. Rousseau
Propolis farinosa (Pers.) Fr.

Propolis cinerascens forma *myriospora* Tul. & C. Tul., *Selecta Fungorum Carpologia* **3**: 126, t. XVI, f. 4 & 7 (1865). [*fide* Saccardo, *Sylloge Fungorum* **8**: 654 (1889).]
Propolina cervina Sacc., *Conspectus Generum Discomycetum hucusque Cognitorum*: 11 (1884). [*fide* Saccardo, *Sylloge Fungorum* **8**: 654 (1889).]

Notes. No reference to *Propolis cinerascens* forma *myriospora* could be found on the analogous pages of Grove's translation of the Tulasnes' work, nor has the combination '*Propolis cinerascens*' been traced.

Propolis circularis Farl., *Flora Withe-Mount.*: 245. [*fide* Saccardo, *Sylloge Fungorum* **8**: 651 (1889).]

Notes. This publication has not been traced, but is possibly a reference to Farlow, W.G., Notes on the cryptogamic flora of the White Mountains. *Appalachia* **3**: 222-?, 1884. According to Saccardo, this species occurs on branches and has asci 60-80 x 7.6-11.5 µm, and ascospores 19-21 x 3.8-5.5 µm. There is therefore no *prima facie* case to remove it from this genus.

Propolis coccinea (Fr.) Sacc., *Sylloge Fungorum* **15**: 306 (1901).
Stictis coccinea Fr., *Elenchus Fungorum* **2**: 24 (1828).
Nectria verrucosa (Schwein.) Sacc., *Sylloge Fungorum* **2**: 509 (1883). [*fide* Nannfeldt, *Bot. Tidskr.* **33**: 316-322 (1929).]

Notes. Nannfeldt's opinion about the synonymy of this species was only tentative.

Propolis cylindricarpa (Peck) Sacc., *Sylloge Fungorum* **8**: 650 (1889).
Stictis cylindricarpa Peck, *Annual Report on the New York State Museum of Natural History* **30**: 63 (1878) '1876'.

Propolis decidua (Ellis & Everh.) Sacc., *Sylloge Fungorum* **8**: 653 (1889).
Stictis decidua Ellis & Everh., *Bulletin of the Torrey Botanical Club* **10**: 76 (1883).

Notes. Currently of unknown application: 'the apothecia which I sectioned no longer contained any intact asci or spores. The general aspect of the species is that of a *Xylogramma*, rather than a *Stictis* or a *Propolomyces*' (Sherwood 1977a).

Propolis dendrobii P.R. Johnst.
Marthamyces dendrobii (P.R. Johnst.) Minter

Propolis desmoschoeni P.R. Johnst.
Marthamyces desmoschoeni (P.R. Johnst.) Minter

Propolis dracophylli P.R. Johnst.
Marthamyces dracophylli (P.R. Johnst.) Minter

Propolis emarginata (Cooke & Massee) Sherwood
Marthamyces emarginatus (Cooke & Massee) Minter

Propolis epilobii Fuckel
Propolis farinosa (Pers.) Fr.

Propolis faginea (Schrad.) P. Karst.
Propolis farinosa (Pers.) Fr.

Propolis faginea forma *cinerascens* (Pers.) Sacc.
Propolis farinosa (Pers.) Fr.

Propolis faginea forma *nivea* (Fr.) Sacc.
Propolis farinosa (Pers.) Fr.

Propolis faginea forma *strobilina* (Desm.) Sacc.
Propolis farinosa (Pers.) Fr.

Propolis faginea var. *atra* E.K. Cash
Propolis farinosa (Pers.) Fr.

Propolis faginea var. *betulae* (Fuckel) Rehm
Propolis farinosa (Pers.) Fr.

Propolis farinosa (Pers.) Fr., *Summa Vegetabilium Scandinaviae* **2**: 372 (1849).
Hysterium fagineum Schrad., *Journal für die Botanik* **2**: 68 (1799).
Propolis faginea (Schrad.) P. Karst., *Bidrag, till Kännedom om Finlands Natur och Folk* **19**: 244 (1871).
Tremella saligna Alb. & Schwein., *Conspectus Fungorum in Lusatiae Superioris Agro Niskiensi Crescentium e Methodo Persooniana*: 303 (1805).
Stictis saligna (Alb. & Schwein.) Pers., *Mycologia Europaea* **1**: 337 (1822).
Propolis saligna (Alb. & Schwein.) Fr., *Summa Vegetabilium Scandinaviae* **2**: 372 (1849).
Sclerotium album DC., *Flore Française* Edition 3 **5/6**: 112 (1815).
Stictis alba (DC.) Fr., *Elenchus Fungorum, sistens Commentarium in Systema Mycologicum* **2**: 27 (1828).
Xylogramma album (DC.) Wallr., *Flora Cryptogamica Germaniae* **2**: 510 (1833).
Propolis alba (DC.) Fr., *Summa Vegetabilium Scandinaviae* **2**: 372 (1849).
Stictis farinosa Pers., *Mycologia Europaea* **1**: 331 (1822).
Stictis farinosa Pers.: Fr., *Systema Mycologicum* **2** (1): 198 (1822).
Propolomyces farinosus (Pers.) Sherwood, *Mycotaxon* **5**: 321 (1977).
Stictis cinerascens Pers., *Mycologia Europaea* **1**: 339 (1822).
Propolis faginea forma *cinerascens* (Pers.) Sacc., *Michelia* **1**: 421 (1878).

Stictis versicolor Fr.: Fr., *Systema Mycologicum* **2** (1): 198 (1822).
Xylogramma versicolor (Fr.) Wallr., *Flora Cryptogamica Germaniae* **2**: 510 (1833).
Propolis versicolor (Fr.) Fr., *Summa Vegetabilium Scandinaviae* **2**: 372 (1849).
Propolomyces versicolor (Fr.) Dennis, *Kew Bulletin* **36**: 685 (1982).
Stictis rhodoleuca Sommerf., *Supplementum Florae Lapponicae*: 198 (1826).
Propolis rhodoleuca (Sommerf.) Fr., *Summa Vegetabilium Scandinaviae* **2**: 372 (1849).
Stictis versicolor var. *strobilina* Desm., *Annales des Sciences Naturelles* Botanique, Sér. 2 **19**: 366 (1843).
Propolis faginea forma *strobilina* (Desm.) Sacc., *Michelia* **1**: 421 (1878).
Propolis rhodoleuca var. *strobilina* (Desm.) W. Phillips, *A Manual of the British Discomycetes*: 375 (1887).
Propolis epilobii Fuckel, *Jahrbücher des Nassauischen Vereins für Naturkunde* **23-24**: 253 (1870).
Propolis parallela Fuckel, *Jahrbücher des Nassauischen Vereins für Naturkunde* **23-24**: 254 (1870).
Propolis rosae Fuckel, *Jahrbücher des Nassauischen Vereins für Naturkunde* **23-24**: 254 (1870).
Propolis rubella Fuckel, *Jahrbücher des Nassauischen Vereins für Naturkunde* **23-24**: 254 (1870).
Propolis transversalis Fuckel, *Jahrbücher des Nassauischen Vereins für Naturkunde* **23-24**: 254 (1870).
Propolis betulae Fuckel, *Jahrbücher des Nassauischen Vereins für Naturkunde* **25-26**: 327 (1871).
Propolis faginea var. *betulae* (Fuckel) Rehm, *Kryptogamen-Flora von Deutschland, Oesterreich und der Schweiz* **1**: 150 (1888).
Propolis versicolor forma *nivea* Sacc., *Michelia* **1**: 61 (1877). [*fide* Saccardo, *Michelia* **1**: 421 (1878). No reference to this name traced on page 61]
Propolis faginea forma *nivea* (Fr.) Sacc., *Michelia* **1**: 421 (1878). [basionym not clearly cited]
Stictis fulva Peck, *Botanical Gazette* **1881**: 36 (1881).
Propolis fulva (Peck) Sacc., *Sylloge Fungorum* **8**: 650 (1889).
Stictis strobilina Cooke, *Grevillea* **11**: 107 (1883).
Propolis strobilina (Cooke) Sacc., *Sylloge Fungorum* **8**: 652 (1889).
Propolis betulae var. *callunae* E. Bommer & M. Rousseau, *Bulletin Royale de la Société de Botanique de Belgique* **29**: 230 (1890).
Propolis viridis Dufour, *Bulletin de la Société Mycologique de France* **12**: 1, tab. 1, fig. 1 (1896).
Propolis faginea var. *atra* E.K. Cash, *Mycologia* **28**: 297 (1936).

Notes. In the case of competition between two sanctioned names, the present Code obliges one to select the first validly published and legitimate one. The epithet '*farinosa*' published by Persoon in 1822 antedates the epithet '*versicolor*' published by Fries in 1823. This species is interpreted broadly here, pending critical revision. *Propolis rhodoleuca*, which Sherwood (1977*a*) regarded as a separate species on account of its 'equilateral, slightly thick-walled' spores is treated as a synonym, principally because of the confusion in much of the literature and in some reference collections surrounding this frequently used name. *Propolis leonis*, which she also regarded as different on account of its 'much larger ascospores' is, however, kept distinct in the present work because there is less confusion: very few records bearing this name exist.

Propolis foliicola Nograsek & Matzer
Marthamyces foliicola (Nograsek & Matzer) Minter

Propolis fulva (Peck) Sacc.
Propolis farinosa (Pers.) Fr.

Propolis gilva (Fr.) Fr., *Summa Vegetabilium Scandinaviae* **2**: 372 (1849).

Stictis gilva Fr., *Scleromyceti Sueciae* no. 436 (1834). [*fide* Fries, *Summa Vegetabilium Scandinaviae* **2**: 372 (1849) and Sherwood, *Mycotaxon* **5**: 187 (1977).]

Notes. This exsiccatum series ran to 340 specimens in the first edition, and 380 specimens in the second edition *fide* Pfister (1985: 108). Sherwood (1977a) was unable to locate a specimen of this exsiccatum, and it is not clear whether this species was ever validly published.

Propolis glauca Ellis, *Bulletin of the Torrey Botanical Club* **1881**: 65 (1881).
Propolidium glaucum (Ellis) Sacc., *Botanische Zentralblatt* **18**: 250 (1884).

Propolis grisea Cooke & Ellis, *Grevillea* **5**: 91 (1877).
Naemacyclus griseus (Cooke & Ellis) Sacc., *Sylloge Fungorum* **8**: 702 (1889).

Notes. The type, Cooke & Ellis No. 2473, in **K**, is on white cedar; in the protologue ascospores are described as being about 100 µm long and filiform. Saccardo's redisposition of this species may thus be correct.

Propolis hederae (P. Crouan & H. Crouan) Sacc., *Sylloge Fungorum* **8**: 652 (1889).
Stictis hederae P. Crouan & H. Crouan, *Florule du Finistère*: 41 (1867).

Notes. Sherwood (1977*a*) reported that this species has 'a white disc 2-3 mm broad and unicellular fusoid spores'; she was unable to borrow the type material, but suspected from the description that it was congeneric with *Propolomyces farinosus* [= **Propolis farinosa**].

Propolis hillmanniana Kirschst., *Annales Mycologici* **33**: 203 (1935).

Notes. According to the protologue, this species has a white disc and aseptate ascospores 40-50 x 10-14 µm. There is therefore no *prima facie* case to remove it from this genus.

Propolis holoschoeni De Not., *Erbario Crittogamico Italiano* ser. 2, **9**: 439 (1871). ['*holoschaeni*' is an orthographic variant]
Hysterostegiella holoschoeni (De Not.) Défago, *Sydowia* **21**: 36 (1968).

Propolis hysterioides (Desm.) Fuckel, *Jahrbücher des Nassauischen Vereins für Naturkunde* **23-24**: 255 (1870).
Stictis hysterioides Desm., *Annales des Sciences Naturelles, Botanique* **19**: 365 (1843).
Hysteropezizella hysterioides (Desm.) Nannf., *Nova Acta Regiae Societatis Scientiarum Upsaliensis* **8**: 118 (1932).

Propolis lecanora (Kunze & J.C. Schmidt) De Not., *Commentario Società Crittogamologica Italiana*, Genoa **1**: 10 (1863).
Peziza lecanora Kunze & J.C. Schmidt, *Deutschlands Schwämme* no. 174 (1817).
Ocellaria ocellata (Pers.) J. Schröt., in Cohn, *Kryptogamen-Flora von Schlesien* **3** (2): 150 (1893).

Propolis leonis (Tul. & C. Tul.) Rehm, *Ascomyceten* Fasc. 8, no. 360 (1876).
Stictis leonis Tul. & C. Tul., *Selecta Fungorum Carpologia* **3**: 127 (1865).
Propolis leucaspis Ellis, *North American Fungi* **1**: 74 (1878). [*fide* Saccardo, *Sylloge Fungorum* **8**: 651 (1889)]

Notes. Accepted by Sherwood as a species distinct from *P. farinosa*.

Propolis leonis var. *weiriana* Sacc., *Nuovo Giornale Botanico Italiano* **27**: 79 (1920).

Notes. On wood of an unearthed root. Differing from the typical variety by its wider asci, 100-120 x 36 µm, and with ascospores 28 x 11-12 µm, *fide* Trotter (1928: 1245). These features are compatible with this species belonging in *Propolis*.

Propolis leucaspis Ellis
Propolis leonis (Tul. & C. Tul.) Rehm

Propolis lobata Cooke & Ellis, *Grevillea* **5**: 91 (1877).

Notes. The type, Cooke & Ellis No. 2444, in **K**, is on maple lying on the ground; according to the protologue the ascospores are about 20 x 8 µm. There is therefore no evidence that this species should be moved from this genus.

Propolis lugubris Speg., *Boletín de la Academia Nacional de Ciencias* Córdoba **11** (2): 271 (1888).
Propolomyces lugubris (Speg.) Gamundí, *Flora Criptogámica de Tierra del Fuego* Buenos Aires **10** (4): 94 (1986).

Notes. Gamundí (1986) re-examined this species and provided a modern illustration. It is clearly a member of *Propolis*, close to *P. farinosa*.

Propolis mezerei Hazsl., *Einig. Discom.*: 2, tab. III, fig. 6. [source of information Saccardo, *Sylloge Fungorum* **8**: 668 (1889).]
Propolidium mezerei (Hazsl.) Sacc., *Sylloge Fungorum* **8**: 668 (1889).

Propolis microsticta Mont., *Cryptogamia Guyanensis*, no. 465 (1850-1855).

Notes. On bark from Guyana, with cylindrical asci 50 µm long and linear, 5-nucleate ascospores, 10 µm long *fide* Saccardo (1889: 668). This seems unlikely to be a species of *Propolis*, but its true position remains uncertain.

Propolis minutula Sacc. & Malbr., *Hedwigia* **1884**: 24 (1884).
Ploettnera solidaginis (De Not.) Hein, *Willdenowia* Beihefte **9**: 96 (1976).

Propolis nivea (Pers.) Fr., *Summa Vegetabilium Scandinaviae* **2**: 372 (1849).
Cyclaneusma niveum (Pers.) DiCosmo, Peredo & Minter, *European Journal of Forest Pathology* **13**: 210 (1983).

Propolis ocellata (Pers.) Sacc., *Fungi Italici Autographice Delineati* no. 1407 (1883).
Peziza ocellata Pers., *Synopsis Methodica Fungorum* **1**: 667 (1801).
Ocellaria ocellata (Pers.) J. Schröt., in Cohn, *Kryptogamen-Flora von Schlesien* **3** (2): 150 (1893).

Propolis panizzei (De Not.) Sherwood
Marthamyces panizzei (De Not.) Minter

Propolis parallela Fuckel
Propolis farinosa (Pers.) Fr.

Propolis parasitica (Ellis & Everh.) Sacc., *Sylloge Fungorum* **8**: 653 (1889).
Stictis parasitica Ellis & Everh., *Journal of Mycology* **4**: 54 (1888).
Dematioscypha dematiicola (Berk. & Broome) Svrček, *Česka Mykologie* **31**: 193 (1977). [*fide* Huhtinen, S., *Karstenia* **29**: 240 (1989)]

Propolis parvula (Speg.) Speg., *Michelia* **2**: 165 (1880).
Ocellaria parvula Speg., *Decades Mycologicae Italicae* **7-12**: 103 (1879).
Ocellaria ocellata (Pers.) J. Schröt., in Cohn, *Kryptogamen-Flora von Schlesien* **3** (2): 150 (1893).

Propolis pinastri Delacr., *Pl. Cr. Fr. Exs.* **2** no. 791 (1861).
Naemacyclus fimbriatus (Schwein.) DiCosmo, Peredo & Minter, *European Journal of Forest Pathology* **13**: 207 (1983).

Propolis phacidioides (Fr.) Corda
Marthamyces phacidioides (Fr.) Minter

Propolis pirina Rehm, *Növénytani Közlemények* **4**: 3 (1905).

Notes. On bark of a member of the *Rosaceae*, with ascospores 18-20 x 8-9 µm, arranged uniseriately, *fide* Saccardo & Trotter (1913: 733). The associated organism, substratum and arrangement of ascospores in the ascus suggest this may be a synonym of *Potebniamyces pyri* (Berk. & Broome) Dennis (1978: 231).

Propolis populi De Not., *Commentario Società Crittogamologica Italiana* **1**: 10 (1863).
Ocellaria ocellata (Pers.) J. Schröt., in Cohn, *Kryptogamen-Flora von Schlesien* **3** (2): 150 (1893).

Propolis prominula (Schwein.) Thüm., *Die Pilze des Weinstockes. Monographische Bearbeitung der sämtlichen bisher bekannten, auf den Arten der Gattung* Vitis *verkommenden Pilze*: 78 (1878).
Stictis prominula Schwein., *Transactions of the American Philosophical Society* **4**: 180 (1832).

Notes. Sherwood (1977a) reported that 'the type specimen consists of erumpent stromatic masses, pale brown in color, containing one or more convoluted locules lined with filamentous projections (conidia? phialides?). This appears to be a coelomycete, but I am unable to place it'.

Propolis psychotriae (Mont.) Mont., *Sylloge Generum Specierumque Cryptogamarum* no. 665 (1856).
Stictis psychotriae Mont., *Annales des Sciences Naturelles* Botanique Sér. 2 **18**: 246 (1842).
Biostictis psychotriae (Mont.) Sherwood, *Mycotaxon* **5**: 40 (1977).

Propolis pulchella Speg., *Boletín de la Academia Nacional de Ciencias* Córdoba **11** (2): 272 (1888).
Propolomyces pulchellus (Speg.) Gamundí, *Flora Criptogámica de Tierra del Fuego* Buenos Aires **10** (4): 95 (1986).

Notes. Gamundí (1986) re-examined this species and provided a modern illustration. It is clearly a member of *Propolis*, close to *P. farinosa*.

Propolis pyri (Berk. & Broome) W. Phillips, *A Manual of the British Discomycetes*: 375 (1887).
Stictis lecanora var. *pyri* Berk. & Broome, *Annals and Magazine of Natural History* **17**: 1144 (1876).
Potebniamyces pyri (Berk. & Broome) Dennis, *British Ascomycetes*: 231 (1978).

Propolis quadrifida (Lév.) Mont.
Marthamyces quadrifidus (Lév.) Minter

Propolis quercifolia (Cooke & Ellis) Sherwood
Marthamyces quercifolius (Cooke & Ellis) Minter

Propolis rhododendri Rehm
Pseudophacidium ledi (Alb. & Schwein.) P. Karst.

Propolis rhodoleuca (Sommerf.) W. Phillips
Propolis farinosa (Pers.) Fr.

Propolis rhodoleuca var. *strobilina* (Desm.) W. Phillips
Propolis farinosa (Pers.) Fr.

Propolis rosae Fuckel
Propolis farinosa (Pers.) Fr.

Propolis rubella Fuckel
Propolis farinosa (Pers.) Fr.

Propolis rubi Rehm, *Ascomyceten* **15**, no. 721 (1883).

Notes. *Pseudophacidium propolidium* Rehm (1888: 96) appears to be another, but illegitimate name for this fungus. In her monograph of *Pseudophacidium*, Egger (1968) did not treat this species name.

Propolis rufa Berk. & Cooke, *Disc. U.S.* **2**: 27. [source of information Saccardo, *Sylloge Fungorum* **8**: 650 (1889)]

Notes. On dead branches, with ascospores 33-37 µm long, *fide* Saccardo (1889: 650). There is therefore no *prima facie* case to remove it from this genus.

Propolis saligna (Alb. & Schwein.) Fr.
Propolis farinosa (Pers.) Fr.

Propolis sorbina P. Karst.
Karstenia sorbina (P. Karst.) P. Karst.

Propolis sphaerelloides Ellis, *Bulletin of the Torrey Botanical Club* **1881**: 124 (1881).

Notes. On *Juncus*, with clavate paraphyses and 1-septate ascospores, *fide* Saccardo (1889: 667). Thought by Nannfeldt (1932) to belong close to *Hysteropezizella* but, *fide* Hein (1983) probably not close to *Diplonaevia*.

Propolis strobilina (Cooke) Sacc.
Propolis farinosa (Pers.) Fr.

Propolis succinea Sacc., *Michelia* **2**: 333 (1881).
Ocellaria succinea (Sacc.) Sacc., *Sylloge Fungorum* **8**: 656 (1889).

Notes. On *Genista*, with ascospores 18-20 x 7 µm, *fide* Saccardo (1889: 656).

Propolis tetraspora Sacc., in Mouton, *Bulletin de la Société Royale de Botanique de Belgique* **26**: tab. 1, fig. 11 (1887).

Notes. This fungus, on dry stems of *Solidago*, was described by Saccardo & Trotter (1913: 733) as having 4-spored asci, with uniseriately arranged ascospores 14-20 x 8-10 µm. This is insufficient information to enable a decision about its correct generic disposition.

Propolis transversalis Fuckel
Propolis farinosa (Pers.) Fr.

Propolis tumidula P. Karst., *Meddelanden af Societas pro Fauna et Flora Fennica* **1**: 186 (1878).

Notes. On small branches of *Salix*, with asci slightly I+, and ascospores 23-28 x 5.5-6 µm. Apart from the slight iodine reaction, there is no evidence to suggest this is not a species of *Propolis*.

Propolis ulmi (P. Crouan & H. Crouan) Sacc., *Sylloge Fungorum* **8**: 652 (1889).
Stictis ulmi P. Crouan & H. Crouan, *Florule du Finistère*: 42 (1867).

Propolis urticae (P. Crouan & H. Crouan) Sacc., *Sylloge Fungorum* **8**: 654 (1889).
Stictis urticae P. Crouan & H. Crouan, *Florule du Finistère*: 42 (1867).

Propolis versicolor (Fr.) Fr.
Propolis farinosa (Pers.) Fr.

Propolis versicolor forma *nivea* Sacc.
Propolis farinosa (Pers.) Fr.

Propolis versicolor var. *lactea* Sacc., *Michelia* **1**: 514 (1879).

Notes. On wood of *Quercus*, with curved aseptate, 2-guttulate ascospores 20-23 x 7 µm. This may be another synonym of *P. farinosa*.

Propolis viridis Dufour
Propolis farinosa (Pers.) Fr.

Propolis weirii Traverso & Trotter, *Sylloge Fungorum* **24**: 1244 (1928).
Rhabdocline weirii A.K. Parker & J. Reid, *Canadian Journal of Botany* **47**: 1540 (1969).

MARTHAMYCES Minter, **gen. nov.**

Etymology: in honour of Martha Sherwood-Pike for her contributions to this group of ascomycetes.

Fungus ad ordinem *Rhytismatalium* et familiam *Rhytismatacearum* pertinens, plerumque foliicola, habet ascomata immersa, pariete superiori induta saepius crystallifera et haud nigra. Ascomata ipsa ascos habent cylindricos in iodo nil coerulescentes, et ascosporas filiformes, hyalinae, septatae.

Typus: *Marthamyces emarginatus* (Cooke & Massee) Minter.

Description. *Habit*: saprobic, usually on leaves and similar substrata. *Ascomata*: apothecial, circular or angular, rarely coalescing, immersed, with little or no lower or side, but a poorly-defined upper wall with a persistent covering layer which often contains crystalline material, with a rather thin subhymenium, and a greyish hymenial surface. *Asci*: cylindrical, with one functional wall layer, maturing sequentially, not bluing in iodine, opening by an apical hole or crack, usually 8-spored, with ascospores arranged in a fascicle. *Ascospores*: colourless, filiform, thin-walled, smooth, usually transversely septate. *Paraphyses*: slender, thin-walled, smooth, aseptate or septate, often branched or flexuous at the tips. *Conidial state*: not observed.

Marthamyces dendrobii (P.R. Johnst.) Minter, **comb. nov.**
Propolis dendrobii P.R. Johnst., *New Zealand Journal of Botany* **24**: 115 (1986). [basionym]

Marthamyces desmoschoeni (P.R. Johnst.) Minter, **comb. nov.**
Propolis desmoschoeni P.R. Johnst., *New Zealand Journal of Botany* **29**: 402 (1991). [basionym]

Marthamyces dracophylli (P.R. Johnst.) Minter, **comb. nov.**
Propolis dracophylli P.R. Johnst., *New Zealand Journal of Botany* **24**: 115 (1986). [basionym]

Marthamyces emarginatus (Cooke & Massee) Minter, **comb. nov.**
Stictis emarginata Cooke & Massee, *Grevillea* **18**: 7 (1889). [basionym]
Propolis emarginata (Cooke & Massee) Sherwood, *Mycotaxon* **5**: 323 (1977).
Coccomyces martiniae Hansf., *Proceedings of the Linnean Society of New South Wales* **81**: 40 (1956).

Marthamyces foliicola (Nograsek & Matzer) Minter, **comb. nov.**
Propolis foliicola Nograsek & Matzer, *Nova Hedwigia* **58**: 30 (1994). [basionym]

Marthamyces panizzei (De Not.) Minter, **comb. nov.**
Stictis panizzei De Not., *Commentario Società Crittogamologica Italiana*, Genoa **1**: 362 (1861). [basionym]
Propolis panizzei (De Not.) Sherwood, *Mycotaxon* **5**: 322 (1977).

Marthamyces phacidioides (Fr.) Minter, **comb. nov.**
Stictis phacidioides Fr., *Systema Mycologicum* **2**: 199 (1822). [basionym]
Propolis phacidioides (Fr.) Corda, *Icones Fungorum hucusque Cognitorum* **2**: 38 (1838).
Naemacyclus phacidioides (Fr.) B. Erikss., *Symbolae Botanicae Upsalienses* **19** (4): 49 (1970).
Stictis anaxaea Speg., *Michelia* **2**: 261 (1881).
Phacidium albidum W. Phillips & Harkn., *Grevillea* **12**: 83 (1884) '1883'.
Coccomyces albidus (W. Phillips & Harkn.) Sacc., *Sylloge Fungorum* **8**: 746 (1889). [*fide* Sherwood (1980: 19).]
Coccomyces quadratus subsp. *ursinus* Sacc. & Paol., *Bulletin de la Société Royale de Botanique de Belgique* **28**: 96 (1889).
Coccomyces ursinus (Sacc. & Paol.) Petr., *Annales Mycologici* **34**: 20 (1936).
Stictis vaccinii Ellis & Everh., *Proceedings of the Academy of Natural Sciences of Philadelphia* **46**: 352, year not noted.
Stictis arctostaphyli Ferdin. & Winge, *Botanisk Tidsskrift* **28**: 253 (1907).
Naemacyclus arctostaphyli (Ferdin. & Winge) Rehm, *Ascomyceten* **47**: 1903 (1910).
Naemacyclus penegalensis Rehm, in Jaap, *Verhandlungen des Botanischen Vereins der Provinz Brandenburg* **50**: 34 (1909) '1908'. [*fide* Eriksson (1970: 49).]
Naemacyclus adeanus Rehm, *Ascomyceten* **47**: 1903 (1910). [*fide* Eriksson (1970: 49); *nom. nud.*]
Stictis myricae E.K. Cash, *Mycologia* **50**: 655 (1958).

Marthamyces quadrifidus (Lév.) Minter, **comb. nov.**

Stictis quadrifida Lév., *Annales des Sciences Naturelles, Botanique* Sér. 3 **5**: 255 (1846). [basionym]

Propolis quadrifida (Lév.) Mont., *Flora Chilena* 7: 425 (1852).

Stictis foliicola Berk. & M.A. Curtis, *Journal of the Linnean Society* Botany **10**: 371 (1868).

Naemacyclus foliicola (Berk. & M.A. Curtis) Dennis, *Kew Bulletin* **14**: 445 (1960).

Stictis chilensis Speg., *Rev. Fac. Agron. Vet. La Plata* **6**: 129 (1910). [*fide* Farr (1973: 1444).]

Stictis coccolobi Seaver & Waterston, *Mycologia* **32**: 399 (1940).

Stictis conocarpi Seaver & Waterston, *Mycologia* **33**: 311 (1941).

Stictis pimentae Seaver & Waterston, *Mycologia* **33**: 313 (1941).

Stictis serenoae E.K. Cash, *Mycologia* **35**: 599 (1943).

Marthamyces quercifolius (Cooke & Ellis) Minter, **comb. nov.**

Stictis quercifolia Cooke & Ellis, *Grevillea* **5**: 50 (1876). [basionym]

Propolis quercifolia (Cooke & Ellis) Sherwood, *Mycotaxon* **5**: 327 (1977).

Stictis quercina Peck, *Annual Report on the New York State Museum of Natural History* **28**: 69 (1876) '1874'.

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ETUDES ULTRASTRUCTURALES DANS LE GENRE COOKEINA (ASCOMYCETES, PEZIZALES, SARCOSCYPHACEAE)

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ABSTRACT

SEM and TEM studies on the apothecium, hymenium, asci, ascal dehiscence and ascospores were performed in *C. tricholoma*, *C. sulcipes* and *C.* (*Boedijnopeziza*) *insititia*. These studies reveal that *C. insititia* and *C. tricholoma* are different enough. So *C. insititia* is placed in the subgenus *Boedijnopeziza* in *Cookeina*. Dehiscence of asci in the whole *Cookeina* genus, characterized by regression of the apical thickened wall with building up of a bilabial dehiscence split, is different of the classic operculate dehiscence known in the Pezizales. The *Cookeina* systematic position is discussed with regard to current molecular taxonomic researches.

RESUME

Des études au MEB et au MET sont faites sur l'apothécie, l'hyménium, les asques et leur déhiscence et sur les ascospores de *C. tricholoma*, *C. sulcipes* et de *C.* (*Boedijnopeziza*) *insititia*. Elles montrent que *C. insititia* diffère suffisamment de *C. tricholoma* pour mériter d'être placé dans un sous-genre de *Cookeina (sous-genre Boedijnopeziza)*. La déhiscence des asques dans l'ensemble du genre *Cookeina* qui comporte une régression de l'épaississement apical et la formation d'une fente de déhiscence bilabiée, est donc différente de la déhiscence operculaire typique des Pezizales. La position systématique de *Cookeina* est discutée en tenant compte des récentes données de la taxonomie moléculaire.

INTRODUCTION

Le genre *Cookeina* a été créé par O. KUNTZE en 1891 avec pour type *C. tricholoma*, et comme autres espèces, *C. sulcipes* et *C. insititia.*, toutes à affinité tropicale. D'autres espèces, également tropicales, y ont été ajoutées ultérieurement, en particulier : *C. colensoi* (SEAVER 1913) ; *C. venezuelae* (LE GAL 1953) ; *C. indica* (PFISTER et KAUSHAL 1984) ; *C. sinensis* (WANG 1997) ; *C.* (*Nanoscypha*) *tetraspora* (DENISON 1972). En 1937 ITO et IMAI ont placé *C. insititia* dans le genre nouveau *Boedijnopeziza*, accepté ultérieurement par RIFAI 1968, par KORF et WARAITCH 1971, et par KORF 1973, mais rejeté par LE GAL 1953 , LIOU et CHEN 1977, PFISTER et KAUSHAL 1984 , ERIKSSON et HAWKSWORTH 1998 et ERIKSSON et *al.* 2001. Selon les travaux cladistiques de CABELLO 1988 et les recherches en systématique moléculaire de LANDVIK et *al.* 1997 et de HARRINGTON et *al.* 1999, *Cookeina* est une *Sarcoscyphaceae*. C'est aussi l'avis d'ERIKSSON et *al.* 2001.

Jusqu'à présent, le genre *Cookeina* n'a donné lieu qu' à peu d'études infrastructurales, aussi bien au MET (MERKUS 1973, 1976 ; SAMUELSON 1975 ; BELLEMERE 1977), qu'au MEB (MELENDEZ-HOWELL 1986 ; MORAVEC 1997). Le présent travail, qui fait suite à nos précédentes publications concernant des *Sarcoscyphaceae* et des *Sarcosomataceae* (Pezizales) (BELLEMERE et *al.* 1990 ; MELENDEZ-HOWELL et *al.* 1990 ; BELLEMERE 1994 ; BELLEMERE et *al.* 1994 ; MELENDEZ-HOWELL et *al.* 1998) apporte diverses données complémentaires, relatives au genre *Cookeina*, obtenues en microscopie électronique à transmission et en microscopie électronique à balayage et susceptibles de préciser les limites et les affinités de ce genre.

MATERIEL ET METHODES

Les échantillons examinés sont les suivants :

Cookeina tricholoma (Mont.) Kuntze. Sur brindilles mortes, Arataye, Guyane Française (Herbier Meléndez-Howell, n° 137, 03-11-1978). Leg. Meléndez-Howell .

Cookeina sulcipes (Berk.) Kuntze. Sur du bois pourri. Turrialba et zone atlantique du Costa Rica (Herbier Meléndez-Howell, n° 5, 8 et 13), 17-09-1987. Leg. Meléndez-Howell.

Peziza insititia Berk. et Curt. Bonin Islands. C. Wright coll. Herbarium of the US North Pacific Exploring Expedition Under Commanders Ringgold and Roggers (1853-1856), n° 148 (PC n° 1011).

Les techniques cytologiques infrastructurales utilisées sont celles qui ont été signalées dans nos précédentes publications relatives à l'ultrastructure des asques en microscopie électronique par transmission, MET, (BELLEMERE 1977, 1994 ; BELLEMERE et *al.* 1994 ; DONADINI et *al.* 1989) et en microscopie électronique à balayage, MEB, (MELENDEZ-HOWELL 1986 ; MELENDEZ-HOWELL et *al.* 1998).

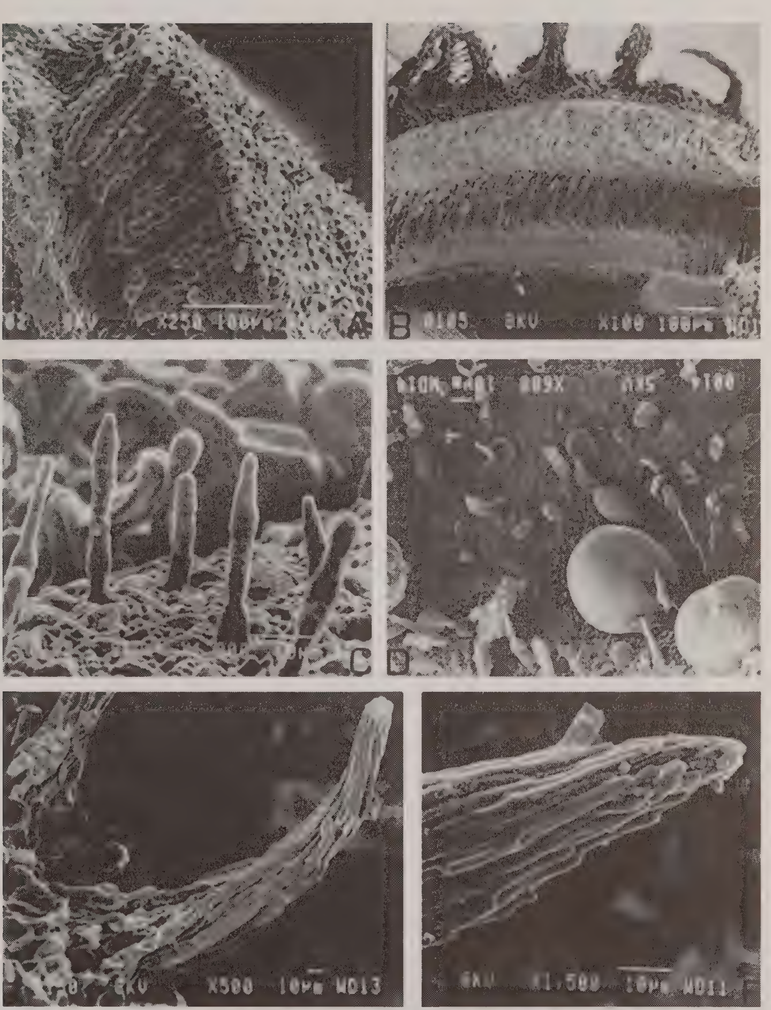
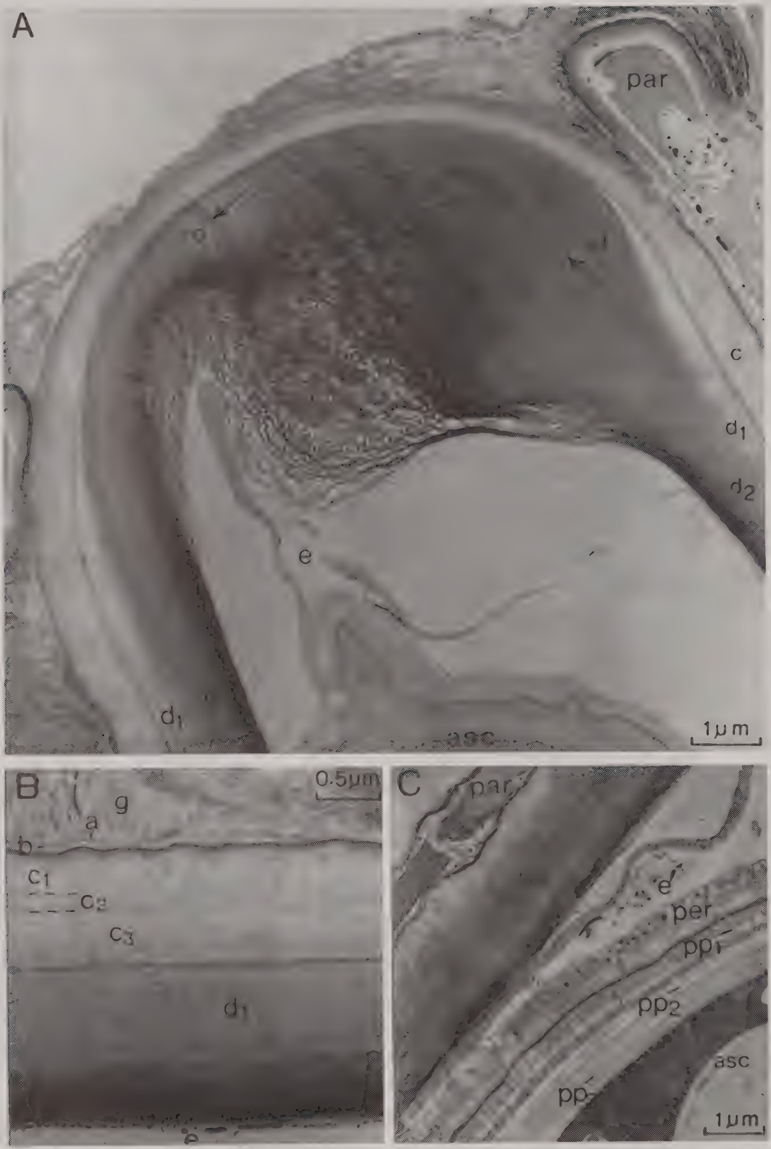


Fig. 1. *Cookeina sulcipes*. Détails anatomiques de l'apothécie (MEB). **A**. – Section de l'hyménium. **B**. – Section de l'hyménium avec vue sur la surface du disque hyménial, parsemé de soies rigides, et sur les poils massifs périhyméniaux. **C**. – Soies hyméniales, détail. **D**. – Poils hyméniaux glanduleux, détail. **E**. – Poil périhyménial massif. **F**. – Détail de l'extrémité d'un poil périhyménial massif.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La terminologie utilisée relativement aux éléments structuraux de la paroi des asques (paroi latérale et apex) et des ascospores, est celle de BELLEMERE 1977 , 1994 et BELLEMERE et *al.* 1981, 1990 , 1994.

RESULTATS

A - *Cookeina tricholoma* et *Cookeina sulcipes*

Ces deux espèces ont déjà fait l'objet, antérieurement, de quelques études infrastructurales au MET, pour la structure de la paroi et de l'apex de l'asque chez *C. sulcipes* (SAMUELSON 1975) et pour l'analyse de l'apex ascal chez *C. tricholoma* (BELLEMERE 1977), ainsi qu'au MEB pour la paroi apothéciale, les ascospores et leur germination chez *C. tricholoma* (MELENDEZ-HOWELL 1986).

1 - Dans l'**HYMENIUM** les asques sont tous au même stade (fig. 1A. *C. sulcipes*, MEB).

Les **paraphyses** (*C. sulcipes*, fig. 3C ; *C. tricholoma*, fig. 2A, MET), souvent un peu plus longues que les asques, épaisses, ramifiées, ont des cellules allongées. Leur paroi est épaissie et différenciée au sommet où elle est recouverte d'un gélin important, réactif au test de Thiéry. Ce gélin se fond dans le gélin hyménial moins réactif (fig. 2A).

On observe des **poils hyméniaux** (*C. sulcipes*, MEB, fig. 1A à C) monostiques, diversement renflés et septés, parfois sécréteurs (fig. 1D). Ils surplombent l'hyménium et sont différents des poils excipulaires (fig. 1E, F) qui sont cloisonnés et groupés en faisceaux coniques aplatis.

2 - Les **ASQUES**, à un stade proche de la maturité, sont très amincis à leur base qui est généralement contournée (*C. sulcipes*, MEB, fig. 4A, B).

La paroi latérale des asques mûrs (*C. tricholoma*, fig. 2A à C, fig. 14B et *C. sulcipes*, fig. 3B, MET), est très épaisse, (environ 2mμ). On y distingue les quatre couches : a, b, c, d (terminologie de BELLEMERE 1977 et de BELLEMERE et *al.* 1994).
La couche a, la plus externe, mince et bien réactive, est recouverte extérieurement d'un gélin abondant, fibrilleux, assez réactif (périascus).
La couche b, très mince et non réactive, n'est distincte qu'aux endroits où la coupe est bien orthogonale à la paroi, et là où la couche a n'est pas trop empâtée par la réaction de Thiéry.
La couche c est épaisse et à peine réactive. On y distingue de l'extérieur vers l'intérieur

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Fig. 2. *Cookeina tricholoma* (MET, technique de Thiéry). **A.** – Apex d'un asque proche de la maturation (*cf.* fig. 14) ; asc, ascospore ; bo, bouchon subapical ; c, couche c de la paroi ; d1 et d2, éléments constituants de la couche d de la paroi ; par, paraphyse. L'ébauche de la zone de déhiscence est indiquée par une flèche. **B.** – Coupe de la paroi latérale de l'asque (*cf.* fig. 14) ; a, c1, c2, c3, d1, d2, couches et sous-couches constitutives de la paroi ; e, épiplasme ; g, gélin externe. **C.** – Coupe de la paroi d'une ascospore (*cf.* fig. 14) ; asc, ascospore ; e, épiplasme ; pa, paroi de l'asque ; par, paraphyse ; per, périspore avec une mince couche basale très réactive et surmontée de deux sous-couches de texture différente ; pp1, pp2, pp3, sous-couches de la paroi propre .

trois sous-couches : c1, c2, c3. La sous-couche c1, relativement mince, a un aspect gris. La sous-couche c2, assez importante, est transparente. La sous-couche c3 est épaisse et grise.

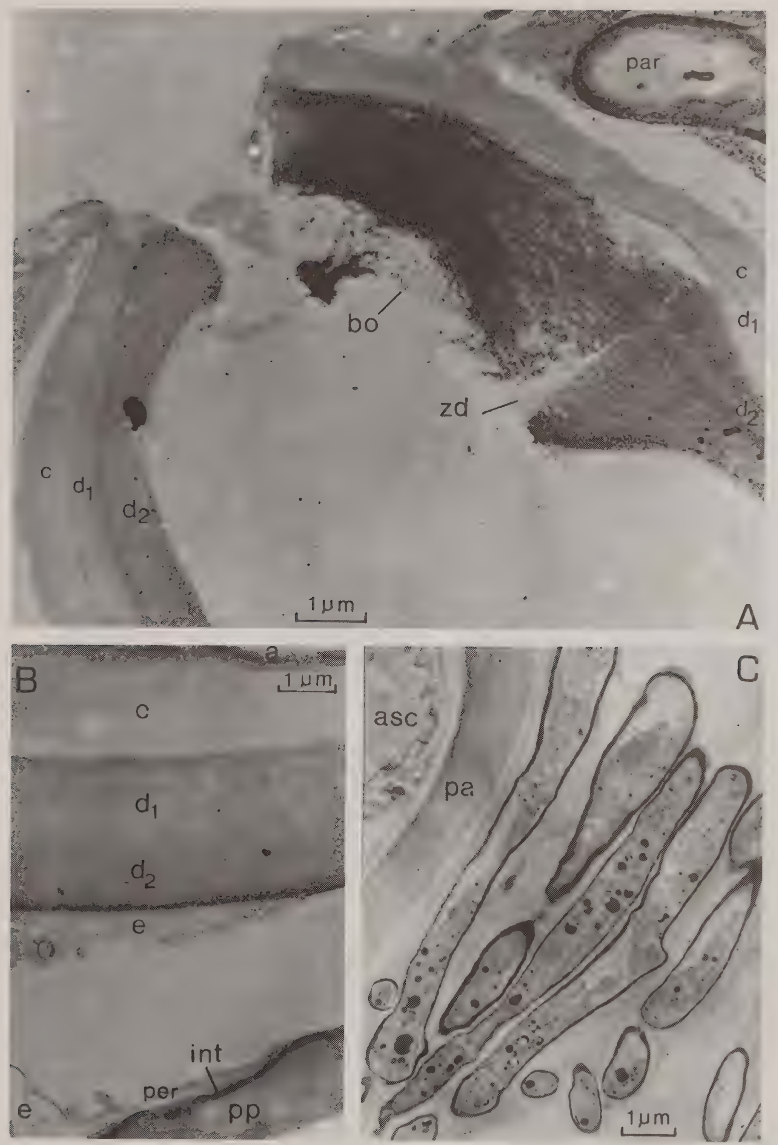
La couche d, reconnaissable à sa structure finement lamellaire est très épaisse (*C. tricholoma,* fig. 2B). Les asques sont donc nettement bituniqués. Cette couche, assez réactive, est constituée de deux sous-couches, d1, externe, et d2, interne, séparées par une mince lamelle plus claire. Elle est délimitée sur chacune de ses faces par un liséré très fin et très sombre. La sous-couche d1, moyennement réactive, est assez épaisse. La sous-couche d2, fortement réactive, l'est moins.

Au **sommet de l'asque** (*C. tricholoma*, fig. 2A et fig. 14A), où le gélin périascal est plus abondant et plus dense, les couches a et b paraissent inchangées, tandis que la couche c est un peu amincie. Dans la couche d, la sous-couche d1 s'amincit progressivement vers l'apex jusqu'à devenir quasi inexistante. La sous-couche d2, qui reste très réactive, s'épaissit brusquement de façon à la fois considérable et dissymétrique. Il se constitue ainsi un bouchon apical (bo) très important, déjeté latéralement. Ce bouchon, de structure lamellaire, est nettement plus compact et beaucoup plus fibrilleux dans sa partie moyenne. Sa partie plus profonde a une texture plus lâche et devient hyaline au contact du plasmalemme. La partie sommitale de l'épiplasme, qui est rétrécie, se trouve disposée sur le côté du bouchon apical. Dans ce bouchon réactif (couche d), la future zone de déhiscence (zd) est déjà distincte. C'est un très mince diaphragme disposé très obliquement par rapport à l'axe d'allongement de l'asque. Sur les coupes (fig. 2A), ses sections apparaissent comme deux minces lignes (flèches, zd). Le sommet de ce diaphragme est un peu latéral par rapport à l'apex de l'asque. Sa base se situe assez bas dans sa région sous apicale, du côté opposé par rapport à l'apex.

3 - DEHISCENCE DES ASQUES (*C. sulcipes*).

En raison de la disposition de la zone de déhiscence, l'orifice de déhiscence qui se forme, est disposé obliquement par rapport à la direction d'allongement de l'asque et il est latéral par rapport à l'apex de l'asque (MET, fig. 3A).

Fig. 3. *Cookeina sulcipes* (MET, technique de Thiéry). **A.** – Déhiscence d'un asque ; c, d, couches de la paroi de l'asque ; bo, bouchon subapical ; zd, zone de déhiscence. **B.** – Coupe de la paroi d'un asque, au voisinage d'une ascospore ; a, c, d, couches de la paroi de l'asque ; e, épiplasme ; per, périspore ; pp, paroi propre de l'ascospore ; int, partie interne de la mince périspore. – *Cookeina tricholoma* (MET, technique de Thiéry). **C.** – Paraphyses à cellules allongées ; asc, ascospore ; pa, paroi de l'asque.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Les examens au MEB (*C. sulcipes*, fig. 4E, F ; fig. 5 ; fig. 7A, B), montrent qu'au cours de l'ouverture de l'orifice de déhiscence, la partie la plus élevée de la paroi de l'asque, s'allonge vers le haut en une languette relativement mince qui surplombe subverticalement cet orifice. En face de cette languette, le bouchon apical s'amincit par régression de sa partie fibrillaire et se réduit à un bourrelet (fig. 3A ; fig. 6E, F).

La déhiscence apparaît donc comme bilabiée, mais les deux lèvres sont différentes : la lèvre supérieure est redressée en languette et l'inférieure se réduit à un bourrelet. La première ascospore en voie d'émission est alors plus ou moins disposée, au sommet de l'asque, comme un bébé sous le capuchon de son landau (fig. 6, schéma). Cette disposition a été figurée antérieurement par LE GAL 1953 (fig. 118, 6) qui a cependant, et à tort selon nous, ajouté un opercule (fig. 118, 12), peut-être pour être en conformité avec les figures de BOEDIJN (1933) (*cf.* aussi, SEAVER 1942, fig. 17h : 288).

Il est remarquable que la languette qui se forme à la déhiscence et qui a un aspect d'opercule ne soit pas, en réalité, homologue de l'opercule des Pezizales typiques à asques symétriques à leur sommet (*cf.* van BRUMMELEN (1975, 1978). Chez celles-ci en effet, comme on le voit par exemple chez *Sarcoscypha*, c'est l'épaississement apical de l'asque qui constitue l'opercule. Au contraire, chez *Cookeina* l'épaississement apical de l'asque, se réduit à un bourrelet bourrelet et n'a ni l'aspect ni le comportement d'un opercule. C'est la languette constituée par la paroi de la partie sous-apicale de l'asque, du côté opposé, qui présente un aspect operculaire. Cette languette par sa forme, par sa faible concavité vers l'extérieur et par une relative rigidité, intervient probablement dans le contrôle de la trajectoire des ascospores émises. Quant au bourrelet, sa structure fibrillaire dense lui confère probablement un rôle de sphincter. On notera, d'une part, le synchronisme des déhiscences et, d'autre part, le strict parallélisme des asques dans un même hyménium (fig. 5A).

La déhiscence de *Cookeina* diffère donc de celle des Pezizales typiques à asques à déhiscence symétrique, par l'absence d'un opercule véritable et par son caractère bilabié.

4 - Les ASCOSPORES subadultes de *C. tricholoma* (fig. 2C, fig. 14B et C et de *C. sulcipes*, fig. 3B, MET).

La **paroi des ascospores** est très épaisse et très différenciée. On y distingue essentiellement, une paroi propre et une périspore séparées par une lamelle onduleuse, très réactive, dont la structure n'a pu être convenablement résolue (paroi intermédiaire ?).

La **paroi propre** est épaisse et complexe. On y distingue trois sous-couches. La plus externe (pp1), la plus réactive, est structurée longitudinalement et transversalement, car on y distingue, à la fois, une lamelle médiane claire et de fins piliers radiaires clairs, très nombreux. La sous-couche moyenne (pp2), plus mince et moins réactive, est structurée longitudinalement par une lamelle sombre. La sous-couche interne (pp3), assez réactive, comporte plusieurs strates longitudinales de réactivité différente.

Ce sont les sinuosités de la paroi propre qui sont responsables de l'ornementation de la paroi de l'ascospore (*C. sulcipes*, MEB, fig. 7D).

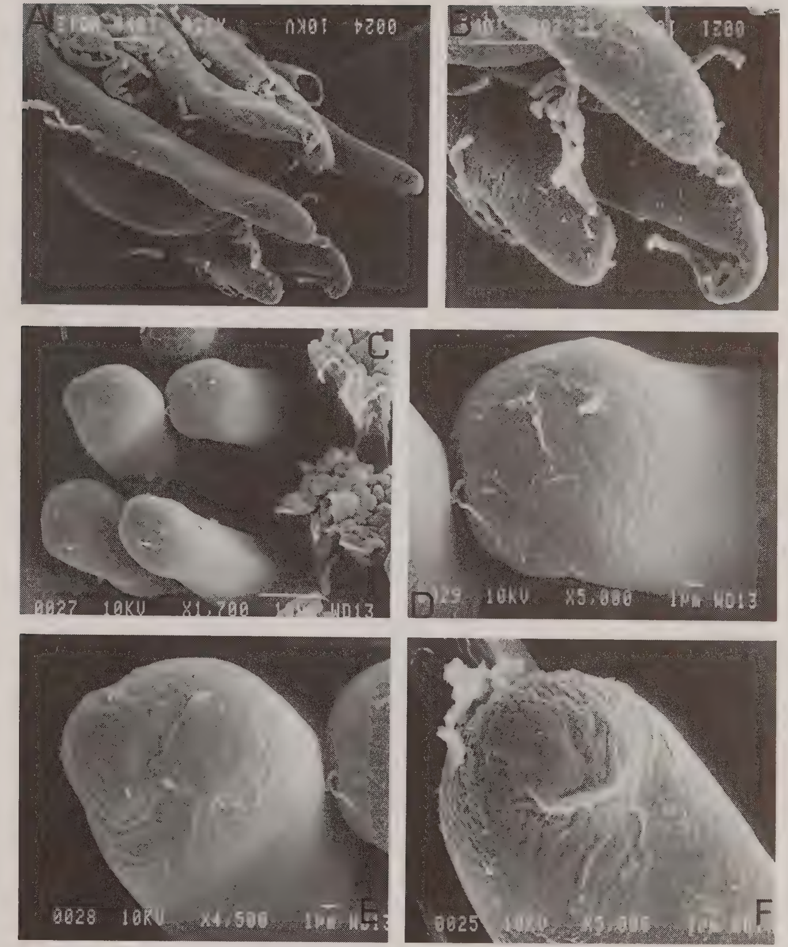
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Fig. 4. *Cookeina sulcipes*. Base et apex d'asques en voie de maturation (MEB). **A**. – Bases très amincies de quelques asques. **B**. – Détail de A. **C**. – Apex de quelques asques en cours de maturation. **D**. – Détail de l'apex d'un asque en cours de maturation. **E**. – Début de différenciation de la zone de déhiscence. **F**. – Détail chez un asque plus âgé que celui de E.

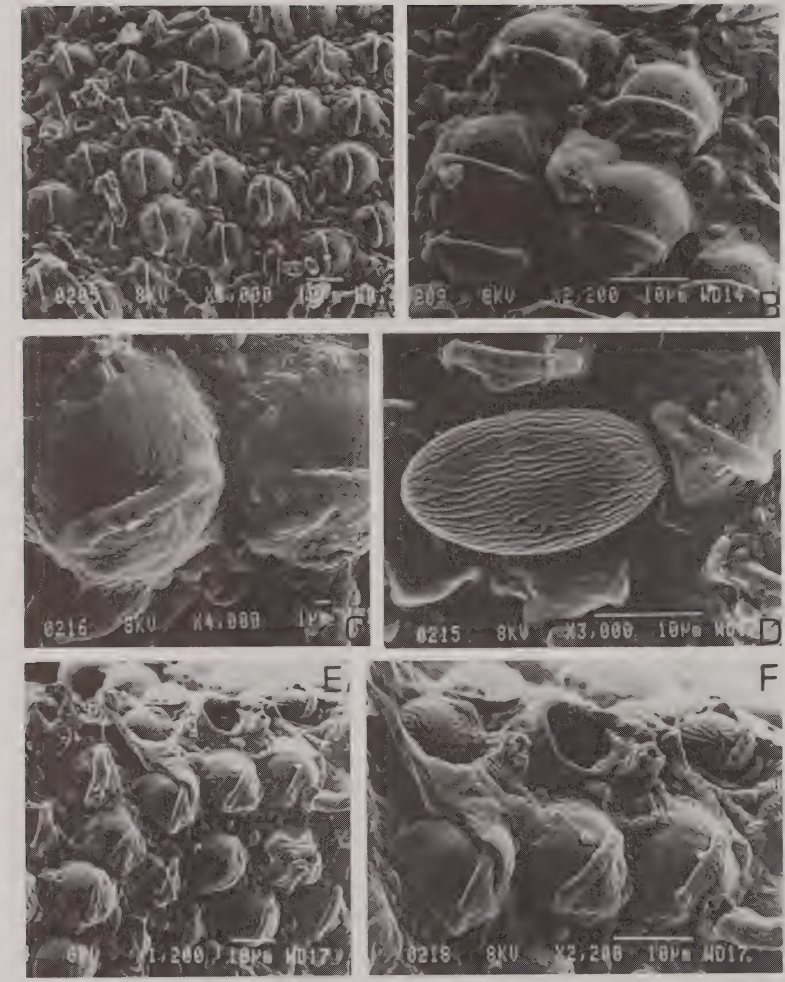
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Fig. 5. *Cookeina sulcipes* (MEB). Déhiscence des asques. **A**. – Sommets d'asques vus en plan à un stade proche de la déhiscence. Les fentes de déhiscence sont verticales et parallèles, avec un impressionnant synchronisme. **B**. – Détail de A. **C**. – Détail de deux asques voisins. **D**. – Ascospore libérée au voisinage d'asques pré déhiscents. L'ornementation de la paroi est typique de *C. sulcipes*. **E**. – Dans la partie supérieure de la photo, quelques asques sont ouverts à leur sommet et libèrent leurs spores. **F**. – Détail de E. Remarquer en haut, à gauche, la dissymétrie du sommet de l'asque ouvert.

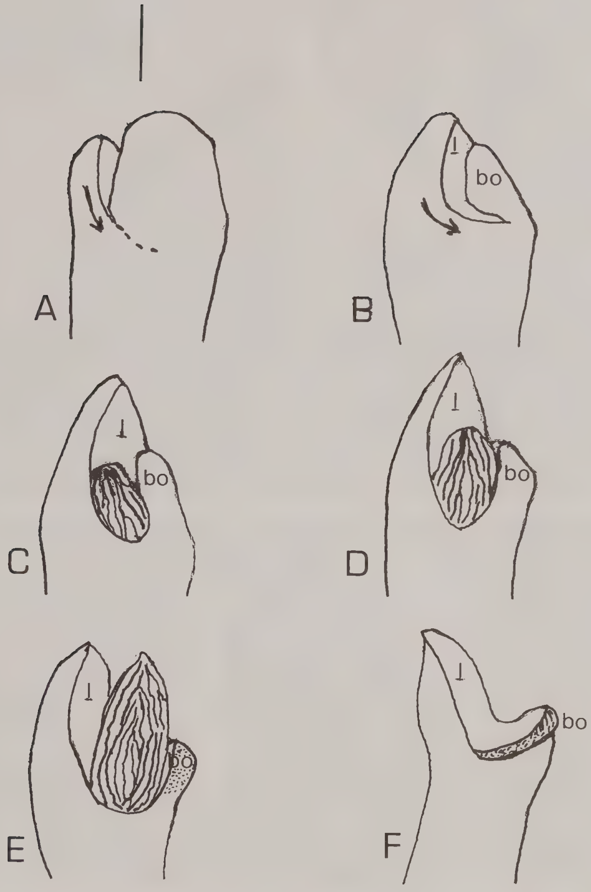

Fig. 6. Déhiscence des asques dans le genre *Cookeina* (Schéma). **A.** – Début d'ouverture de la fente de déhiscence dans la région subaxiale de l'asque : l'emplacement de l'axe de symétrie de l'asque est indiqué par une barre verticale. **B.** – Fin d'ouverture de la fente de déhiscence. Début d'extension de la lèvre supérieure de l'ouverture (l). Début de régression du bouchon subapical (bo). **C.** – La lèvre (l) s'allonge. Le bouchon apical (bo) se réduit à un bourrelet. **D.** – La lèvre (l) est allongée en languette, le bourrelet se contracte et constitue la lèvre inférieure qui maintient la première ascospore (début du stade « en landau »). **E.** – L'ascospore force le passage. **F.** – Asque après déhiscence.

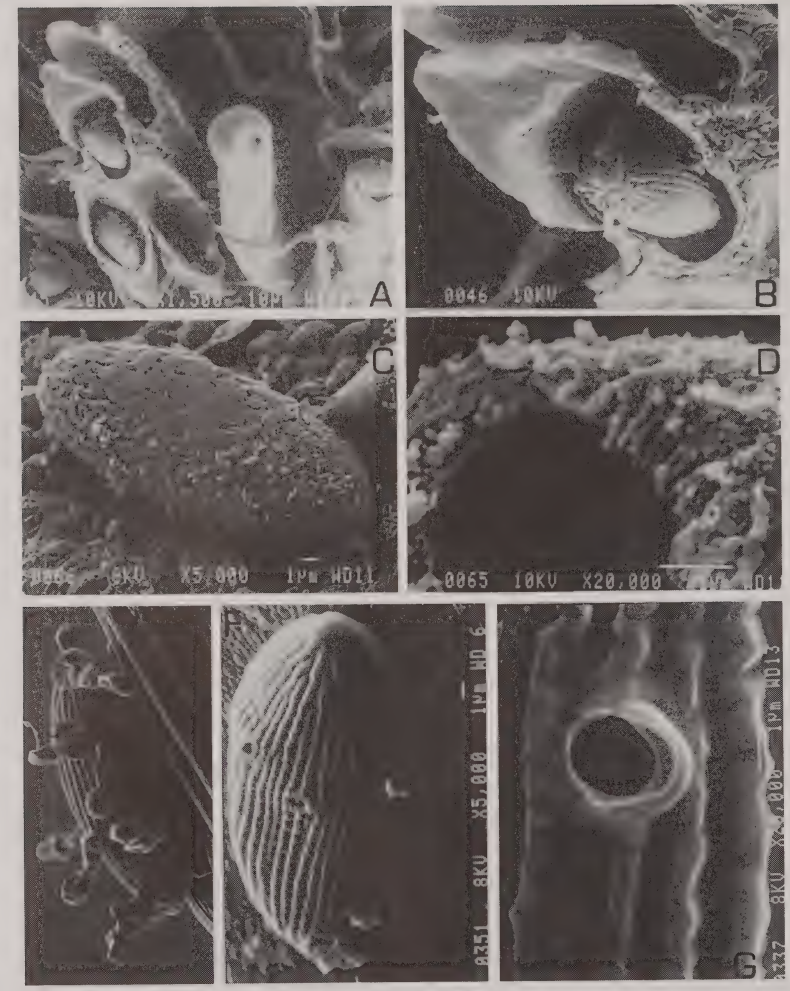
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Fig. 7. *Cookeina sulcipes*. **A**. – Asques déhiscents vus en plan, certains avec une ascospore en cours d'émission. **B**. – Détail de A. Remarquer, vers le haut, la languette à large base et, à l'opposé, le bourrelet relativement réduit. **C**. – Ascospore récemment libérée avec encore des restes de périspore en désagrégation. **D**. – Coupe de la paroi ascosporale montrant, sous des résidus de périspore, les circonvolutions ornementales de la paroi propre. – *Cookeina tricholoma*. **E**. – Ascospore en germination à la partie supérieure d'un poil excipulaire massif. **F**. – Multiplicité des pores germinatifs sur une ascospore. **G**. – Pore germinatif. Remarquer l'irrégularité de la surface légèrement épineuse des crêtes ornementales.

La **périspore**, relativement mince, ne comporte pas de structure lamellaire aussi affirmée que la paroi propre ; on y distingue cependant, une partie externe et une partie interne. L'externe, plus réactive, contient de nombreuses petites granulations réactives, disposées de façon désordonnée. Une mince couche limitante externe réactive, est nette à l'extérieur de la périspore.

Dans le **sporoplasme**, on trouve généralement de gros globules lipidiques et des grains de glycogène.

5 - LA GERMINATION DES ASCOSPORES

A l'émission, les ascospores de *C. sulcipes* (fig. 7A, B) et *C. tricholoma*, (fig. 7E, MEB) peuvent rester recouvertes, au moins en partie, par un mince film de périspore qui masque plus ou moins leur ornementation (fig. 7C). Celle-ci résulte de l'organisation en crêtes longitudinales plus ou moins confluentes (fig. 5D, MEB) des sinuosités de la paroi propre (fig. 5D). La surface des crêtes est irrégulière et semble porter de courtes expansions parfois plus ou moins épineuses (*C. tricholoma* fig. 7F, G, MEB).
La germination des ascospores se fait par de multiples pores germinatifs (MELENDEZ-HOWELL 1986). On constate ici, que ces pores ne sont pas disposés de façon régulière et que leur position est indépendante de celle des crêtes ornementales de la paroi.

B - *Cookeina insititia* (= *Boedijnopeziza insititia*).

1 - HYMENIUM

A la **marge de l'hyménium, l'excipulum** (fig. 8A à D, MEB), porte une couronne de poils triangulaires massifs qui sont constitués d'hyphes parallèles contiguës, portant des mâcles cristallines et de nombreuses masses globuleuses très petites, probablement sécrétées à la surface des filaments. Ces poils massifs, hygroscopiques, peuvent s'enrouler en hélice.

Dans l'hyménium, les **paraphyses** généralement un peu plus courtes que les asques, peuvent quelquefois les surplomber. Leur sommet, un peu renflé , est alors appliqué sur l'apex de l'asque voisin et recouvert d'un gélin assez abondant, réactif au test de Thiéry. La paroi des paraphyses comporte deux couches (fig. 8E à G, MEB et fig. 9A, MET).

2 - Les ASQUES, nombreux, sont brusquement et très fortement amincis à leur base (fig. 11A).
La **paroi latérale des asques** observée au MET (fig. 10B et C), apparaît très nettement bituniquée. La tunique externe, épaisse (couche c), est très distinctement séparée de la tunique interne (couche d), également épaisse. Elle est recouverte d'un gélin clair (périascus) assez abondant, à fibrilles réactives disposées de façon assez désordonnée. La couche b n'a pas été observée. La couche c, assez claire, est constituée de trois strates assez mal délimitées. La plus interne est épaisse et légèrement réactive, alors que la mince strate externe l'est moins. La strate médiane est hyaline. La couche d a une fine structure lamellaire. Elle est dans l'ensemble plus réactive que la couche c. On y distingue deux sous-couches, d_1 et d_2. La sous-couche d_1, externe, plus mince, est plus réactive. Elle comporte trois fines strates. La strate médiane est hyaline ; les strates bordantes sont fortement réactives. La sous-couche d2, un peu plus épaisse que d1, s'amincit graduellement vers la base de l'asque où elle devient indistincte (fig. 10 et

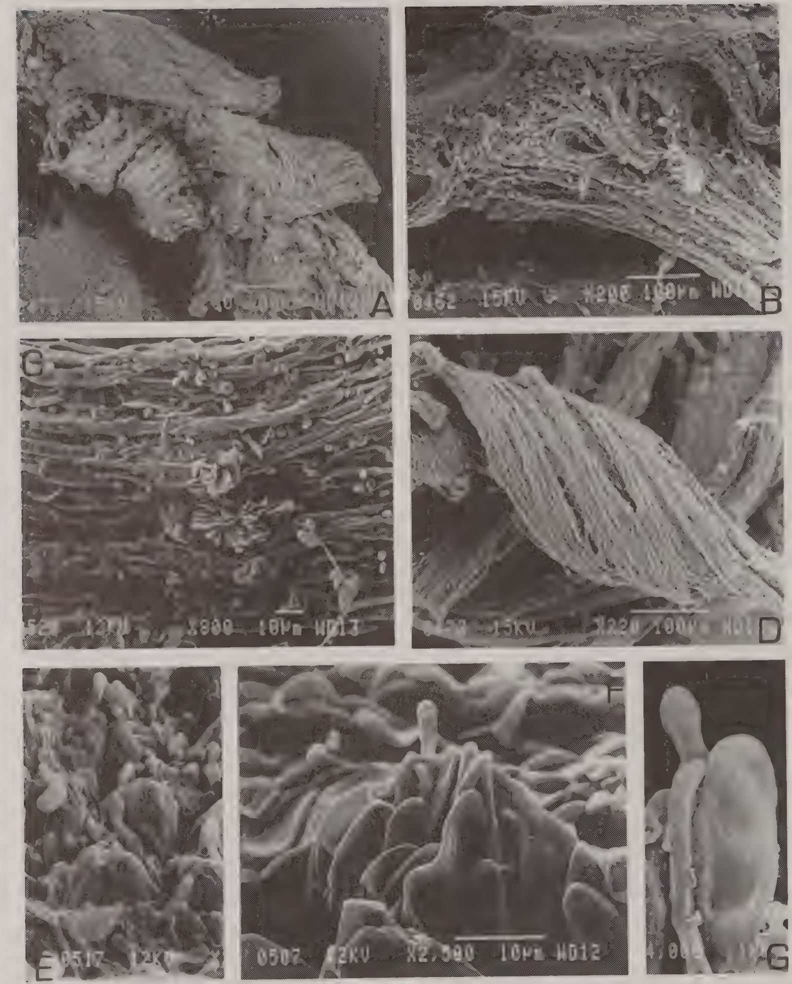
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Fig. 8. *Cookeina* (*Boedijnopeziza*) *insititia* (MEB). Détails anatomiques de l'excipulum et de l'hyménium. **A**. – Poils périhyméniaux très massifs, en languette. **B**. – Détail de A. **C**. – Disposition en faisceau des hyphes sur le poil. **D**. – Poil massif enroulé en hélice. **E**. – Vue surplombante de l'hyménium : sommets d'asques et de paraphyses avec quelques poils hyméniaux. **F**. – Détail de E. **G**. – Asque et paraphyse.

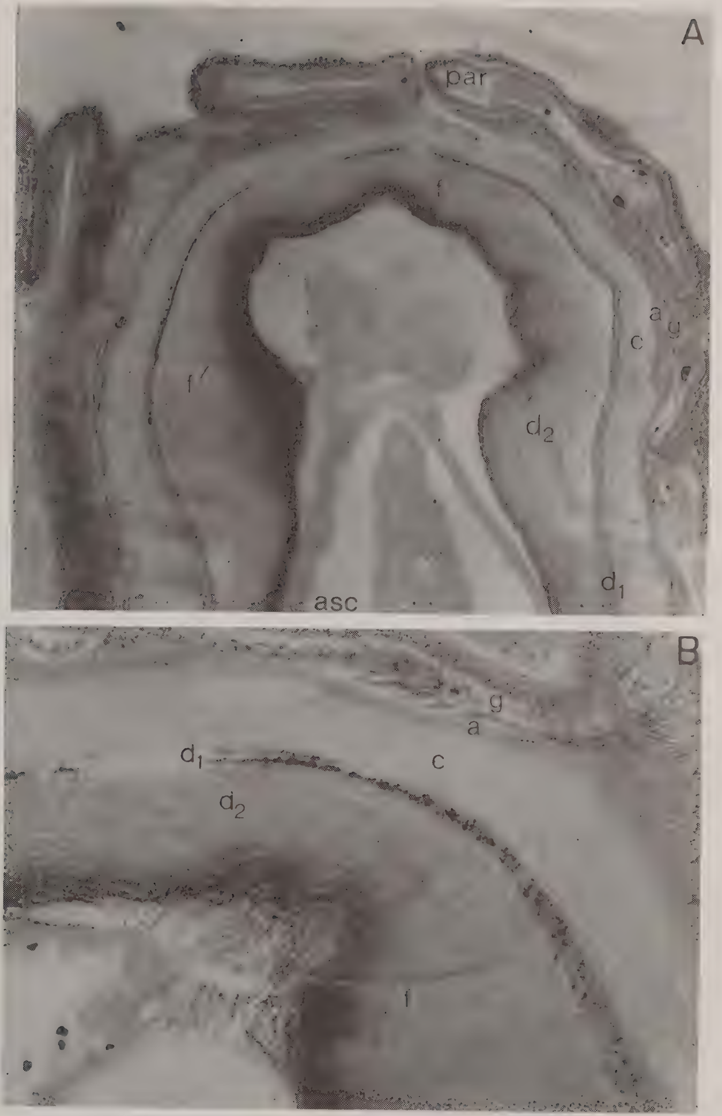
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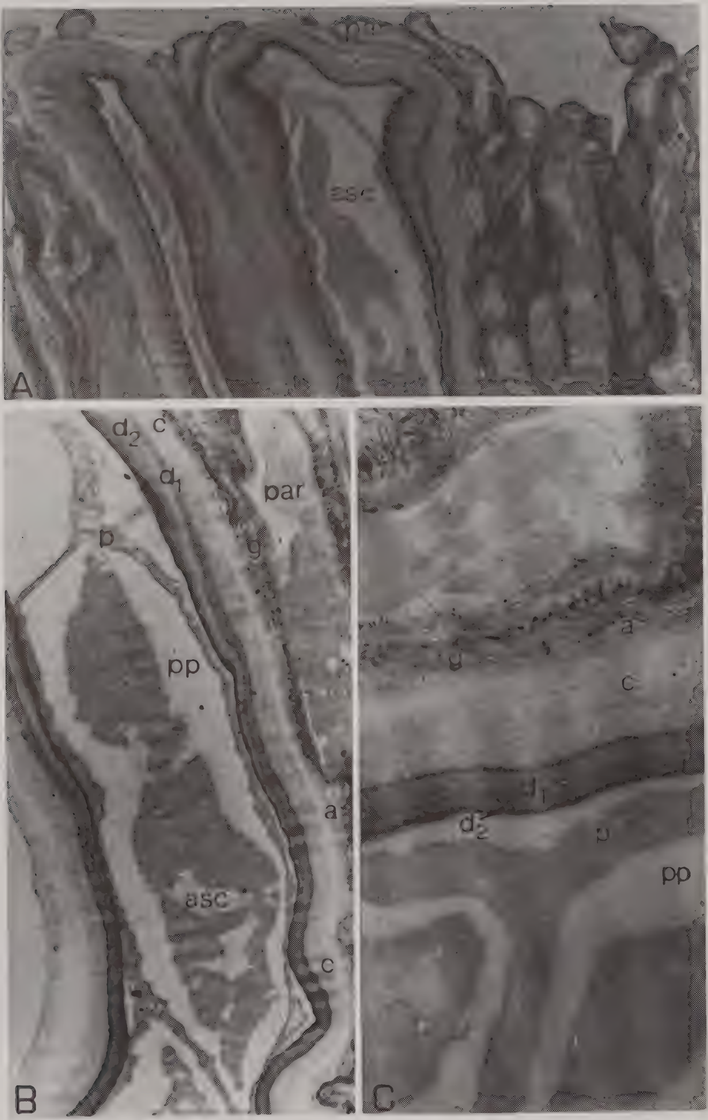
Fig. 9. *Cookeina* (*Boedijnopeziza*) *insititia*. Asque (MET, technique de Thiéry). **A**. – Apex d'asque avec le sommet d'une ascospore et paraphyses ; a, c, d1, d2, strates de la paroi ascale ; asc, ascospore ; f, fente de déhiscence ; g, gélin externe ; par, paraphyse. **B** – Détail de la paroi de l'asque.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13B MET). En même temps, la sous-couche d1 s'épaissit et devient plus fortement réactive. Par contre, la couche c n'est pas sensiblement modifiée.

Le **sommet de l'asque** (fig. 9, 10A, 13, MET) n'est que faiblement dissymétrique. La couche c s'y amincit un peu et de façon graduelle. Ici, la couche d n'est fortement épaissie que dans la partie sous-apicale de l'asque, au-dessus du sommet de l'ascospore supérieure, et c'est surtout la sous-couche d2 qui est concernée. A l'apex de l'asque la couche d n'est pratiquement pas plus épaisse que dans la paroi latérale. Une zone de déhiscence est présente dans la couche d. Elle est très oblique par rapport à l'axe d'allongement de l'asque, car, sur les coupes, on observe sa section à la fois tout près de l'axe de symétrie de l'asque, et aussi, latéralement, un peu au-dessus de l'épaississement maximal de la couche d .

3 - La **DEHISCENCE** des asques n'a pu être observée au MET. Les rares figures obtenues au MEB (fig. 11F, G), montrent une déhiscence faiblement bilabiée, avec une lèvre surplombante peu marquée, opposée à un bourrelet assez étendu qui présente peut-être une symétrie bilatérale, et qui, en se rétractant, se rabat vers le bas.

4 - **LES ASCOSPORES** (fig. 10B et 13C, D, MET), ellipsoïdales allongées, ont à chaque pôle, un appendice subconique important.
La **paroi propre**, épaisse, a un aspect clair. Elle est dépourvue de différenciation interne et semble amincie à chaque extrémité de l'ascospore, où elle forme une sorte de mucron que coiffe un appendice périsporique (fig. 10B, MET et fig. 11B, C, MEB). La surface externe de la paroi propre est onduleuse (fig. 10B, C et 13C, MET). Ces ondulations constituent les ornementations saillantes en forme de crêtes longitudinales, que révèle le MEB à la surface des ascospores (fig. 11, B à E).

b - La **périspore**, assez mince et faiblement réactive, a une texture plus ou moins caverneuse (fig. 10B, C, MET). Elle recouvre l'ensemble de la spore y compris ses mucrons polaires.

Fig. 10. *Cookeina* (*Boedijnopeziza*) *insititia.* Asque et ascospore (MET, technique de Thiéry). **A.** – Coupe frontale de l'hyménium montrant deux asques et des paraphyses. **B.**– Section longitudinale subaxiale d'une ascospore encore contenue dans un asque . Remarquer l'absence de d vers la base de l'asque (base du cliché) et son développement en direction de son sommet où c s'amincit. La périspore forme une apophyse au sommet de la spore. **C.** – Paroi de l'asque dans sa partie inférieure et deux ascospores contiguës accolées par leur périspore ; a, c, d1, d2, couches de la paroi ascale ; g, gélin périascal ; par, paraphyse ; per, périspore ; pp, paroi propre de l'ascospore .

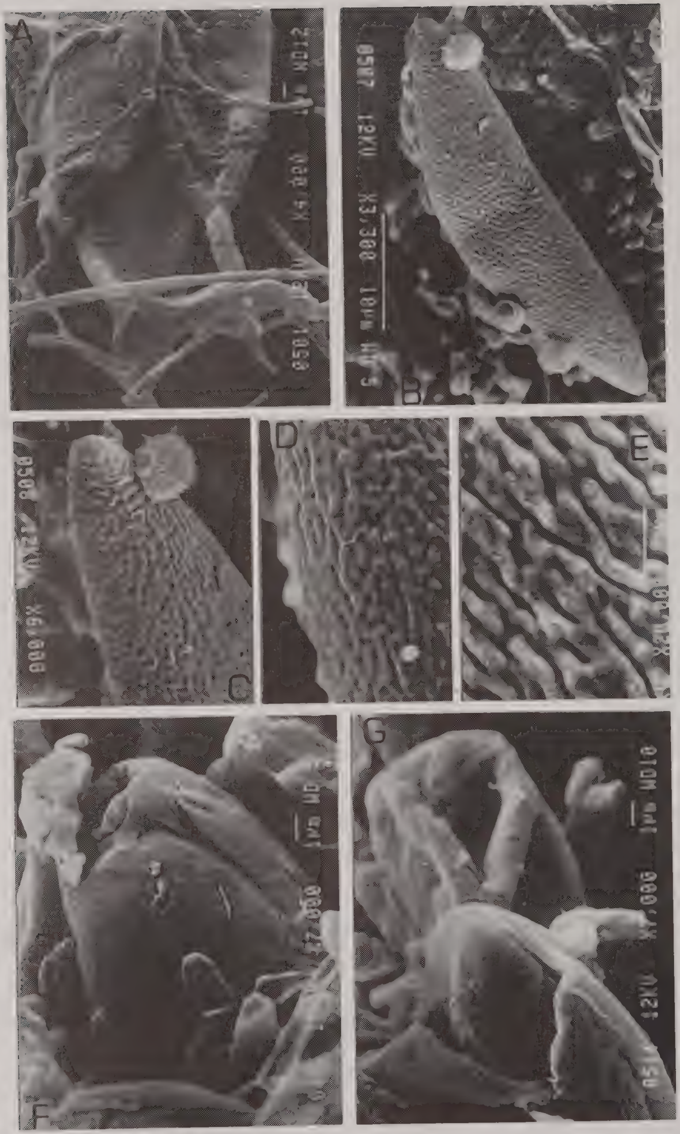

Fig. 11. *Cookeina (Boedijnopeziza) insititia*. Asques et ascospores (MEB). **A**. – Bases d'asques très rétrécies. **B**. – Ascospore (avec adhérence des spores étrangères, anamorphe ?). **C**. – Détail de B. Remarquer le mucron apical non ornementé. **D**. –

5 - La **GERMINATION DES ASCOSPORES** n'a pu être observée. Lors des études au MEB, nous avons seulement constaté dans notre matériel, la présence d'un hyphomycète filamenteux générateur des conidies en tonnelet, à paroi fortement ornementée d'un réseau en saillie (fig. 12, MEB). Nous n'avons pu identifier cet hyphomycète faute d'une familiarité suffisante avec les *Imperfecti*. La probabilité d'un contaminant a été envisagée. Toutefois, deux faits ont retenu notre attention. D'une part, un filament conidiogène a été observée tout près de l'apex d'une ascospore, appliqué contre son mucron apical (fig. 12C, D), dans une possible zone de germination (deux observations distinctes). D'autre part, les conidies ont une ornementation en réseau saillant qui rappelle celle des ascospores. Par suite l'existence d'un anamorphe reste possible. Cependant aucun hyphomycète analogue n'a pas été signalé chez des *Sarcoscyphaceae* (PADEN 1984). Nous nous limiterons donc à rapporter ces observations sans en tirer de conclusion.

DISCUSSION

A - ***Faut-il séparer un genre Boedijnopeziza du genre Cookeina*** ?

Il y a des ***ressemblances*** entre *C. insititia* (*Boedijnopeziza*) et *C. tricholoma* (ou *C. sulcipes*) susceptibles de les faire considérer comme congénériques. Ainsi chez les deux espèces :

Les **asques** ont une même forme générale et sont effilés à leur base qui est plus ou moins sinueuse et flexueuse. Ils sont bituniqués et la couche d de la paroi est nettement subdivisée en deux sous-couches d1-d2. La couche c, qui comporte trois sous-couches, est épaissie. La couche a et le gélin externe (périascus), sont similaires. La zone de déhiscence est oblique, avec une face verticale subsagittale, ce qui laisse supposer que chez *C. insititia*, la déhiscence est probablement du même type que chez *C. tricholoma*. L'ornementation des **ascopores** résulte d'ondulations externes de la paroi propre. La structure de celle-ci, et celle de la mince périspore plus ou moins fugace qui la recouvre, sont analogues.

L'**hyménium** est riche en gélin.

Les **paraphyses** sont du même type et des poils hyméniaux sont présents, ainsi que des poils excipulaires.
La morphologie générale de l'**apothécie** est similaire.
Ces espèces sont essentiellement **tropicales ou subtropicales**.

Ornementation externe de la paroi sporale. **E.** – Détail de D. Disposition réticulée de l'ornementation. **F.** – Sommet d'asque. Au second plan un asque déhiscent dont la languette sommitale est recouverte d'un fragment d'épihyménium d'aspect clair. **G.** – Sommets d'asques déhiscents. Au premier plan le bourrelet plus ou moins déchiré est rabattu en avant, la languette est en arrière. Au second plan, après la déhiscence, le bourrelet, en avant, est plié en V. La languette, en arrière, n'est plus fonctionnelle. Elle est rabattue vers l'intérieur de l'asque.

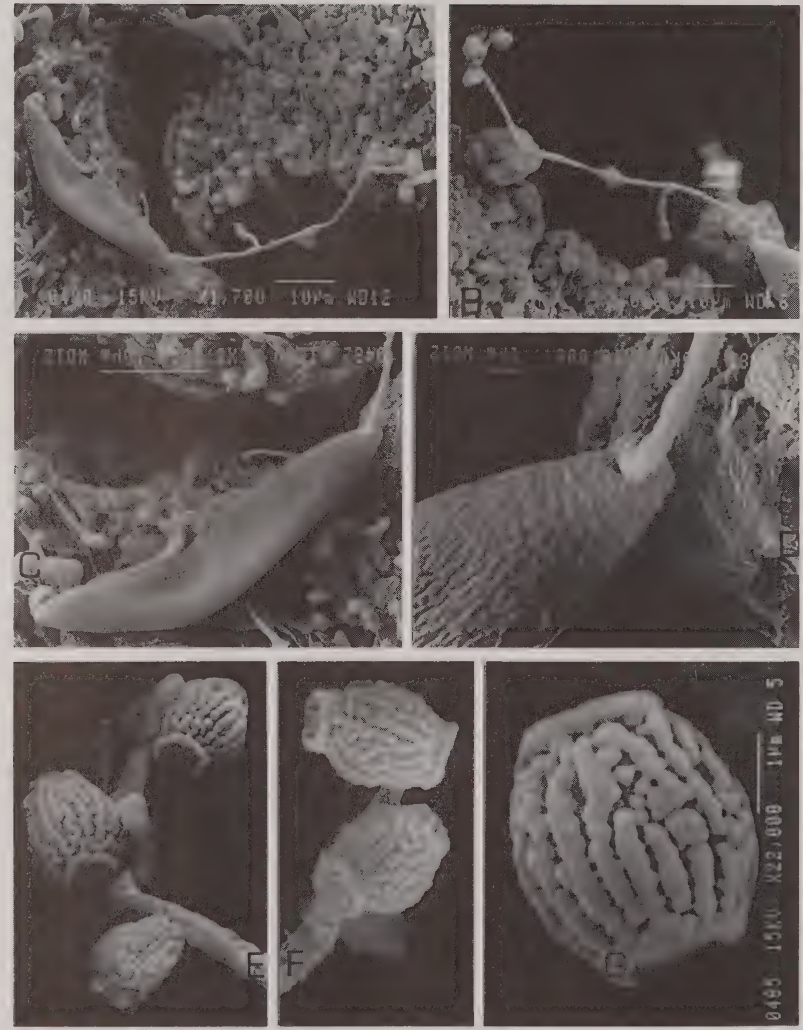

Fig. 12. *Cookeina (Boedijnopeziza) insititia*. Anamorphe? **A-B**. – Filament hyphal apparemment né au voisinage immédiat du sommet d'une ascospore et portant des conidies holoblastiques. **C-D**. – Détail de A et B. **E-F**. – Disposition des conidies sur le filament hyphal. **G**. – Ornementation de la paroi des conidies.

Cependant des ***différences*** notables qui existent entre les *Cookeina* typiques et *C. insititia* ne sont pas en faveur d'un caractère congénérique de ces espèces.

Ainsi dans la **paroi latérale des asques** de *C. insititia*, la sous-couche d1 est moins développée mais elle est mieux individualisée ; la sous-couche d2 est plutôt moins réactive et, vers la base de l'asque, elle se réduit et s'efface.

Au **sommet de l'asque**, chez *C. insititia*, la dyssimétrie n'est pas très marquée, l'épaississement de d est sous-apical et non sub-apical. L'amincissement de c est à peine marqué. La déhiscence, d'après les figures des auteurs, pourrait être aussi un peu différente (BOEDIJN 1933, SEAVER 1942, fig. 17i).

Les **ascospores** de *C. insititia* se distinguent par leur morphologie: elles sont allongées, assez pointues et un peu étranglées dans leur partie médiane ; elles ont des appendices apicaux plus nets. La structure de leur paroi propre est moins complexe.

Les **poils hyméniaux** chez *C. insititia* sont différents de ceux de *C. sulcipes* et, apparemment, ne sont pas sécréteurs (fig. 8E et F, MEB).

La **morphologie et la structure de l'apothécie**, étudiées au MEB, montrent chez *C. insititia* une couronne de poils marginaux coniques aplatis, massifs et hygroscopiques, à hyphes parallèles contiguës portant extérieurement des mâcles cristallines et des masses globuleuses secrétées (fig. 8A à D). Les poils excipulaires, plus courts, ont la même structure. Chez *C. sulcipes*, la structure des poils périhyméniaux massifs n'est pas la même (fig. 1B, E, F). La partie interne de l'excipulum ectal est de *textura globulosa* chez *C. insititia*, alors qu'elle est composée de cellules angulaires allongées chez *C. tricholoma* (RIFAI 1968).

L'étude de **l'ontogénie de l'apothécie** semble montrer que l'hyménium est exposé depuis le début chez *C. tricholoma* (PFISTER 1978). Par contre, le développement serait cleïstohyménial chez *C. insititia* (BOEDIJN 1933) comme il l'est chez d'autres *Sarcoscyphaceae* telles que *Chorioactis* (HEALD et WOLF 1910, SEAVER 1942), ou chez des *Sarcosomataceae* telles que *Plectania melaena* (PFISTER 1978), *Urnula* (DAVIDSON 1950) et *Neournula* (?) (PADEN et TYLUTKI 1968). Toutefois chez *C. insititia*, PFISTER 1978, n'a pas observé de membrane couvrant l'hyménium des jeunes exemplaires. Mais WANG 1997, affirme que cette membrane est présente, « mais qu'il ne s'agit pas d'une membrane réelle ». L'ontogénie de l'apothécie de *C. insititia* semble donc être un peu différente de celle de *C. tricholoma*.

Toute décision relative à la position de *C. insititia*, dépend cependant de la valeur systématique que l'on accorde à chacun des caractères considérés ci-dessus. On doit aussi prendre en compte les variations morphologiques notables, qui encore mal connues, affectent les espèces du genre *Cookeina*, et qui laissent supposer l'existence possible des formes intermédiaires entre *C. tricholoma* et *C. insititia*.

En **conclusion**, faute d'arguments décisifs, nous pensons qu'il paraît raisonnable, pour l'instant, de ne pas placer *C. insititia* dans un genre séparé de *Cookeina*. Mais en raison, en particulier, de la faible dissymétrie des asques à bouchon apical relativement peu marqué, de l'absence de sous-couche d2 à l'extrême base de l'asque, des ascospores allongées-fusiformes avec un étranglement médian et de la *textura globulosa* de l'excipulum interne, il semble qu'il faille placer *C. insititia* dans un sous-genre de *Cookeina* : le sous-genre *Boedijnopeziza*. Une conclusion définitive concernant le niveau systématique de *C.* (*Boedijnopeziza*) *insititia*, ne pourra être dégagée sans apports de documents nouveaux, en particulier moléculaires.

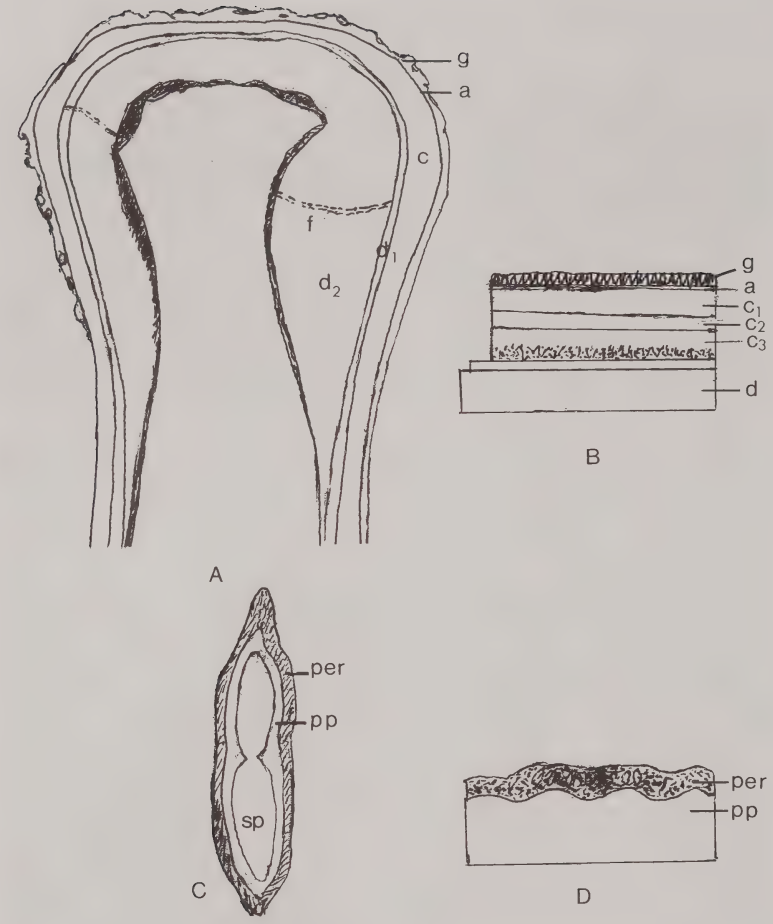

Fig. 13. *Cookeina* (*Boedijnopeziza*) *insititia*. Schémas interprétatifs de la structure de l'asque et de l'ascospore. **A.** – Structure de la paroi à l'apex de l'asque ; a, c, d1, d2, couches et sous-couches de la paroi ; f, fente de déhiscence ; g, gélin périascal. **B.** – Paroi latérale de l'asque (vers la base de l'asque à gauche, et vers le sommet à droite) ; a, c, d, couches de la paroi ascale ; g, gélin périascal. **C.** – Ascospore ; per, périspore ; pp, paroi propre ; sp, sporoplasme. **D.** – Paroi ascosporale ; per, périspore ; pp, paroi propre.

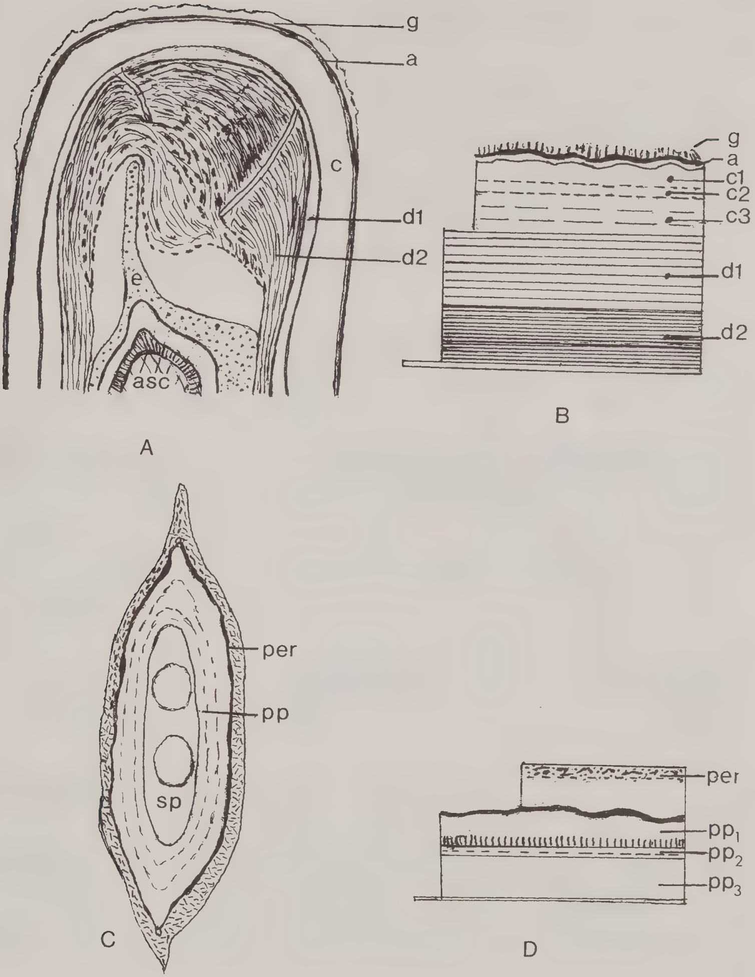
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Fig. 14. *Cookeina tricholoma* (*cf.* fig. 2). **A**. – Schéma de l'apex d'un asque. **B**. – Coupe schématique de la paroi latérale d'un asque ; a, c1, c2, c3, d1, d2, couches et sous-couches de la paroi ; asc, ascospore ; e, épiplasme ; g, gélin externe. **C**. – Coupe schématique d'une ascospore ; per, périspore ; pp, paroi propre ; sp, sporoplasme. **D**. – Coupe schématique de la paroi d'une ascospore ; per, périspore ; pp1, pp2, pp3, sous-couches de la paroi propre (pp).

B - *Position systématique du genre Cookeina s.l. (inclus le sous-genre Boedijnopeziza).*

Le genre *Cookeina* est classiquement placé dans les *Sarcoscyphaceae*. Les études récentes de taxonomie moléculaire concernant cette famille (LANDVIK et *al*, 1997 ; HARRINGTON et *al*. 1999), ont confirmé qu'elle est complexe. Elle comporte au moins deux clades (fig. 15, d'après HARRINGTON et *al*., 1999, schématisé). L'un renferme *Chorioactis*, *Desmazierella*, *Neournula* et *Wolfina*. L'autre clade est composé de trois sous-clades : *Glaziella*, *Wynnea* et un groupe de genres ou *Cookeina* et *Microstoma* sont frères d'un ensemble comprenant entre autres *Sarcoscypha*, *Pithya* et *Phillipsia*.

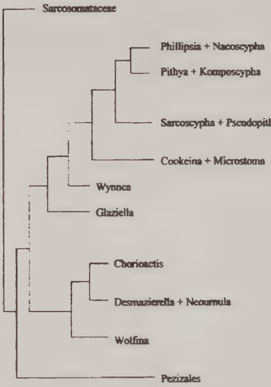

Fig. 15. Relations évolutives dans les *Sarcoscyphaceae* (schéma d'après HARRINGTON et *al*., 1999).

Cette phylogénie est un peu inattendue. Ainsi par exemple, on est surpris que les genres *Desmazierella* et *Chorioactis* se trouvent rassemblés dans un clade séparé des autres *Sarcoscyphaceae*. En effet, les asques de *Desmazierella* sont d'un type proche de ceux de *Sarcoscypha* et la déhiscence bilabiée des asques de *Chorioactis* n'est pas sans rappeler celle des *Cookeina*.

Dans le clade principal il n'est pas étonnant que *Cookeina* et *Microstoma*, dont les asques dissymétriques au sommet ont un bouchon très développé et une base effilée et contournée, se séparent de l'ensemble contenant entre autres, *Sarcoscypha* et *Pithya*. Mais on ne s'attendait pas à ce que *Microstoma* se trouve dans un même sous-clade que *Cookeina*, car chez son espèce type, *M. protracta*, les asques s'ouvrent nettement par un opercule qui est étroit, l'orifice de déhiscence ayant l'aspect d'un pore (SEAVER 1942, ECKBLAD 1978 fig. 7). On doit remarquer cependant, que les conclusions de HARRINGTON et *al*. 1999, reposent sur l'étude d'une espèce différente, *M. floccosa*, dont les relations avec *M. protracta* restent encore insuffisamment précises, en particulier au niveau de la structure fine de l'asque.

Par ailleurs, il est surprenant que *Wynnea* et *Phillipsia*, dont les asques ont un bouchon apical très important, ne se placent pas près de *Cookeina*.

Il résulte des données taxonomiques moléculaires évoquées ci-dessus, que des caractéristiques morphologiques essentielles des asques des *Sarcoscyphaceae* (importance et étendue de la couche d, subdivision éventuelle de celle-ci en d1 et d2, importance de l'épaississement apical, dissymétrie de l'apex, mode de déhiscence) ne semblent pas intervenir directement dans la définition des clades et des sous-clades. Une quelconque des caractéristiques ci-dessus peut, en effet, se retrouver dans les divers sous-clades de la famille. Ceci laisse supposer que chacune d'entre elles ne dépend que d'un petit nombre de gènes qui, à priori, ne sont pas déterminants pour l'évolution générale du clade.

En d'autres termes, il semblerait que certains caractères structuraux des asques qu'on pouvait penser acquis de longue date, et donc être tout à fait significatifs d'un point de vue systématique, aient pu, en fait, évoluer dans un passé plus récent qu'on ne l'imaginait et que leur valeur systématique soit moindre qu'on a pu l'envisager.
Une telle modalité d'évolution est déjà connue en ce qui concerne le type de déhiscence des asques. On sait que celui-ci n'est pas en relation directe avec la structure fine de l'appareil apical (*cf.* BELLEMERE 1994). A cet égard, un type de déhiscence rappelant celui des *Cookeina*, semble se rencontrer chez certaines *Thelebolaceae* (*Thelebolus*, *Caccobius*, *Ramgea*, van BRUMMELEN 1998), famille dont les affinités systématiques restent encore incertaines d'après les récentes études de taxonomie moléculaire (LANDVIK et *al.* 1998, MORI et *al.* 2000, GERNANDT et *al.* 2001, STCHIGEL et *al.* 2001).
Ces considérations conduisent à penser que la diversité des *Sarcoscyphaceae* a pu apparaître de façon relativement « récente », dans un groupe « primitif » qui possédait initialement de multiples potentialités évolutives, et qui a constitué un rameau latéral à la base de l'arbre évolutif des Pezizales.

L'indépendance évolutive de certains caractères des asques et la possibilité de leur manifestation en apparence aléatoire, se retrouve dans d'autres groupes d'Ascomycètes. Elle a conduit à la révision des conceptions systématiques pour certains d'entre eux (par exemple chez les Lichens, fragmentation des Caliciales et rattachement de certaines d'entre elles aux Lecanorales ; chez les Pyrénomycètes, contradictions rencontrées dans la systématique des Sordariales ; nécessité de créer des ordres nouveaux : Chaetothyriales, Lulworthiales, etc.).

La multiplication de travaux de taxonomie moléculaire et d'études ultrastructurales conjointes paraît indispensable à la clarification de nos idées relatives à l'évolution des Ascomycètes supérieurs. Les *Sarcoscyphaceae* semblent être, à cet égard, un matériel d'étude favorable.

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MYCOTAXON

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A NEW SPECIES OF HYPOGYMNIA AND A NEW RECORD IN THE LICHEN FAMILY PARMELIACEAE (ASCOMYCOTA) FROM SIKKIM, INDIA

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ABSTRACT : *Hypogymnia sikkimensis* (Parmeliaceae) from Sikkim, India is described as new to science. In addition, *Allocetraria flavonigrescens* is reported for the first time from India.

KEY WORDS: *Hypogymnia sikkimensis, Allocetraria flavonigrescens*

The lichen flora of eastern Himalayan region is renowned for its diversity (K. Singh & Sinha 1994; K. Singh, 1999; Sinha, 1999). In a continuation of this study we are now describing a further new species from Sikkim. Throughout the present work chemical constituents were identified by thin layer chromatography (Culberson 1972; Culberson & Johnson 1982; Elix & Ernst-Russell 1993), high performance liquid chromatography (Feige *et al.* 1993; Elix & Wardlaw 2002) and comparison with authentic samples.

Hypogymnia sikkimensis G.P. Sinha & Elix, sp. nov. Fig. 1

Thallus ut in *Hypogymnia zeylanica* sed lobis lineariter elongatis et acidum usnicum et acidum isousnicum continente differt.

Type: INDIA. Sikkim: East Sikkim, surroundings of Mei-menchu Lake, 3200-3500 m, on moss-covered tree, *G. P. Sinha 1477A,* 18 September 1998; holo: BSHC; iso: CANB.

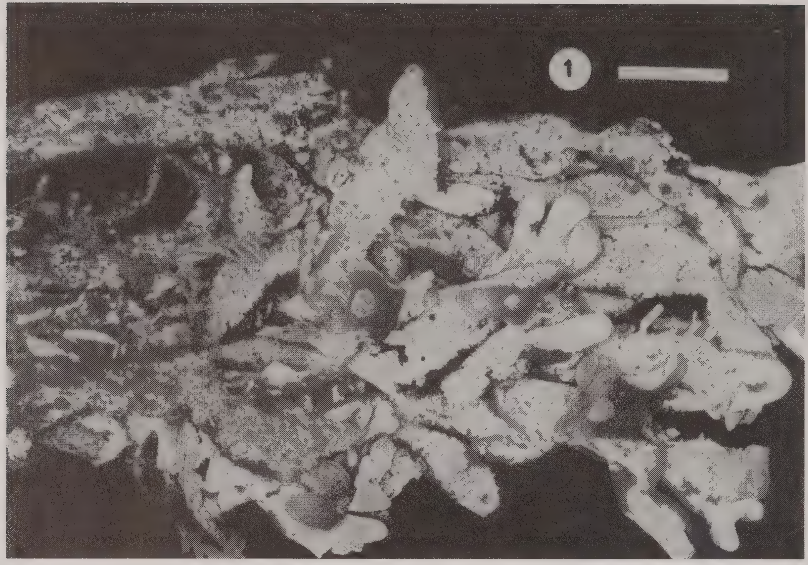

Figure 1. *Hypogymnia sikkimensis* (isotype in CANB). Scale bar = 5.0 mm.

Thallus corticolous, foliose, loosely adnate, to 6 cm wide. *Lobes* separate to imbricate, linear-elongate, subdichotomously branched, 1.5-4.0 mm wide; evenly inflated and hollow throughout. *Upper surface* pale grey to grey or yellowish-grey, with irregular black patches and black margins, convex to ±flattened in older lobes, white maculate, lacking soredia but with isidia and lobules; isidia scattered, globose then short-cylindrical, ±ultimately becoming procumbent, flattened and lobulate, isidia apices syncorticate, intact; lobulae marginal or laminal, linear, simple, 1.0-2.0 mm long, 0.3-0.5 mm wide. *Medulla* white at first, but soon darkening and becoming blackened adjacent to the lobe cavity. *Lower surface* black, brown at the apices, minutely wrinkled, with large, ellipsoidal, subapical perforations, 1.0-1.5 x 0.5-1.0 mm. *Apothecia* and *pycnidia* not seen.

Chemistry. Cortex K+ pale yellow; medulla K-, C-, KC-, P-; containing usnic acid (major), isousnic acid (major), atranorin (minor), chloroatranorin (minor), placodiolic acid (trace), pseudoplacodiolic acid (trace).

Hypogymnia sikkimensis resembles *H. zeylanica* (R. Sant.) D. Awasthi & K. Singh, as these two species produce similar isidia and lobules. However, *H. sikkimensis* can clearly be separated from *H. zeylanica* by the linear-elongate lobes (sublinear to sublinear-elongate in *H. zeylanica*), the scattered, globose then short-cylindrical isidia which may become ultimately procumbent, flattened and lobulate (in contrast to the fragile, cylindrical isidia of *H. zeylanica* which may become coralloid-branched and/or ultimately granular and subsorediate) and the chemistry. Thus *H. sikkimensis* contains usnic acid (major), isousnic acid (major), atranorin (minor) and chloroatranorin (minor) whereas *H. zeylanica* contains atranorin (major), physodic acid (major), oxyphysodic acid (major) and chloroatranorin (minor). At present, this new species is known only from the type locality.

A New Record of Parmeliaceae for Sikkim, India

Allocetraria flavonigrescens A.Thell & Randlane in Daniels *et al.* (eds), *Flechten Follmann:* 359 (1995)

Allocetraria flavonigrescens is distinguished by the yellow, dorsiventral upper surface, the dark brown to black lower surface, the lack of pseudocyphellae and the presence of fumarprotocetraric acid in the medulla. This species is known from Nepal and China (Randlane *et al.* 2001; Thell *et al.* 1995).

Specimen Examined
INDIA. North Sikkim: Llonakh Valley, Muguthang to Nakula track, 4500 m, on exposed boulders in alpine desert, *G. P. Sinha 1575* (BSHC).

ACKNOWLEDGEMENTS

We thank Stuart Hay and Neal McCracken of the Photographic Unit, ANU, for preparing the photograph. One of the authors (GPS) would like to thank Dr. M. Sanjappa, Director, Botanical Survey of India, Kolkata, for providing facilities and encouragement.

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MYCOTAXON

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NEW SPECIES IN THE GENUS SCLEROPHYTON (ASCOMYCOTA, OPEGRAPHACEAE) FROM AUSTRALIA AND THE SOLOMON ISLANDS

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ABSTRACT: *Sclerophyton conspicuum*, from Australia, and *S. hillii, S. insularum* and S. *maculatum*, from the Solomon Islands, are described as new to science. Stictic acid, present in *S. hillii* and *S. maculatum*, represents the first report of this acid in the genus *Sclerophyton.*

KEY WORDS: *Sclerophyton conspicuum, Sclerophyton hillii, Sclerophyton insularum, Sclerophyton maculatum*, stictic acid

The recent catalogue of the lichens of the smaller Pacific Islands (Elix & McCarthy 1998) lists only one report of the genus *Sclerophyton viz*: *S. elegans* Eschw. (as *Stigamatidium elegans* var. *glaucoviresens* Nyl.) from New Caledonia (Nylander 1868). Two species, *S. circumscriptum* (Taylor) Zahlbr. and *S. rostratum* Egea & Torrente were recently reported from Australia (Archer & Elix 2003) but the genus *Sclerophyton* has not been reported from the Solomon Islands. This paper describes an additional new species from Australia and three new species from the Solomon Islands; the latter were collected during the Royal Society Expedition to study the natural history of the islands in 1965 (Corner 1969). Stictic acid, present in *S. hillii* and *S. maculatum,* is reported for the first time in the genus *Sclerophyton.*

The specimens from the Solomon Islands are housed in BM and the Australian specimens are in CANB. Chemical constituents were identified by thin-layer chromatography (Culberson 1972) and where necessary their identity was confirmed by liquid chromatography (Feige *et al*. 1993).

Sclerophyton conspicuum A.W. Archer, *sp. nov.* Fig. 1

Similis *Sclerophyton elegans* sed lirellis majoris simplicibus et ascosporis longioribus differt.

Type: AUSTRALIA. Northern Territory, 6 km SE of Darwin, 12°29'S, 130°54'E, alt. 1 m, among mangroves, on *Exoecarya agallocha* branches, *H. Streimann 48684,* 23.vii.1991; holotype: CANB.

Thallus crustose, corticolous, off-white to greyish white, surface smooth and dull. *Ascosmata* conspicuously lirellate, black, semi-immersed, with a thin thalline margin, 1-3 mm long, 0.2-0.35 mm wide, straight or curved, rarely branched, terminally rounded or acute, or acute at one end only. *Disc* black, dull, epruinose. *Proper exciple* brown, thin, *ca*. 20 μm thick. *Hymenium* 80-100 μm tall. *Paraphyses* branched and anastamosing. *Asci* 60-70 x 16-20 μm, 8 spored. *Ascospores* 25-30 μm long, 4-6 μm wide, (6-)7-8 locular. *Pycnidia* not seen.

Chemistry: psoromic acid (major), 2'-*O*-methylpsoromic acid (trace) and subpsoromic acid (trace).

Also examined:
AUSTRALIA. Northern Territory, Rapid Creek, 8 km NNE of Darwin, 12°23'S, 130°52'E, on mangroves in mangrove swamp, *J.A. Elix 22603*, 26.v.1988 (CANB).

Sclerophyton conspicuum is distinguished from other species in the genus by the large, conspicuous, simple, lirellate ascomata. Lirellate ascomata in the genus are usually narrow and much branched, as in *S. elegans* and *S. inscriptum* (Egea & Torrente 1995, Figs. 33, 36) and *S. indicum* (Makhija & Adawadkar 2002, Fig. 1F) but the ascomata in *S. conspicuum* are large, conspicuous and simple, somewhat resembling lirellae in the Graphidaceae. However the internal structure (*viz*: thin, brown proper exciple and branched, anastomosing paraphyses), the ascospores (brown at maturity) and the chemistry (psoromic acid) place the species in the genus *Sclerophyton*.
The species is so far known only from two specimens from northern Australia, where it occurs on mangroves.

Sclerophyton hillii A.W. Archer, *sp. nov.* Fig. 2

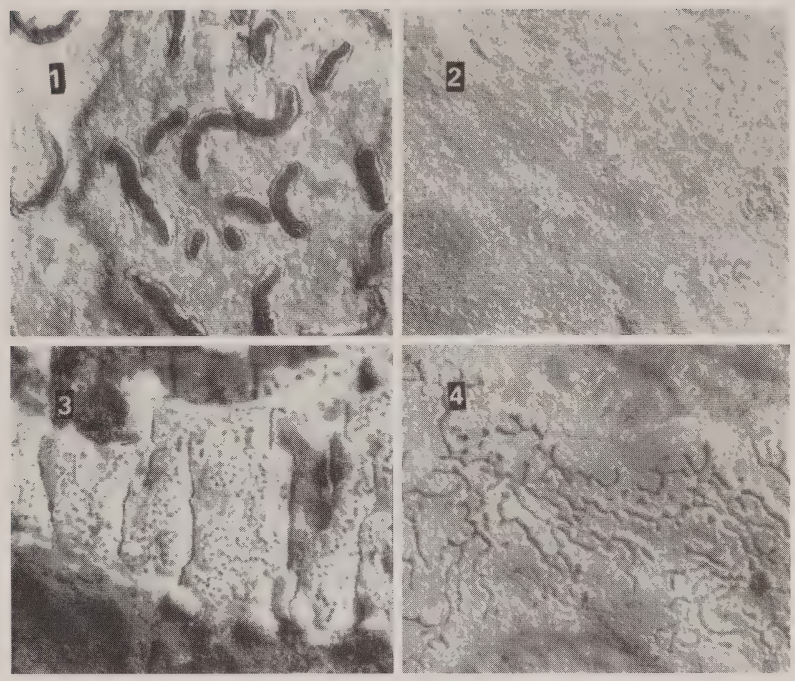
Similis *Sclerophyton rostratum* sed ascosporis minoribus et acidum sticticum continens vice acidum psoromicum differt.

Type: SOLOMON ISLANDS. Kolombangara Island, 2 miles [3.2 km] up Kolombangara River, in lowland rainforest, *D.J. Hill 10266*, 25.viii.1965; holotype: BM.

Thallus crustose, corticolous, pale greyish green, surface smooth and dull. *Ascomata* brown, punctiform, immersed, up to 0.05 mm diam., aggregated in inconspicuous, pale fawn, stroma-like structures *ca*. 1 mm diam. *Proper exciple* undifferentiated. *Hymenium* 50-70 μm tall, paraphyses branched and anastomosing. *Asci* 40-50 x 10-12 μm, 8 spored. *Ascospores* narrow ellipsoid, brown, 18-22 μm long, 5-6 μm wide, 5-6 locular. *Pycnidia* not seen.

Chemistry: stictic acid (major), cryptostictic acid (trace) and peristictic acid (trace).

Sclerophyton hillii is characterised by punctiform ascomata immersed in inconspicuous, stroma-like structures, the 5-6 locular ascospores and the presence of stictic acid. Although collected at the same time and from the same locality as *S. maculatum* (*vide infra*) and possessing the same unusual (for the genus *Sclerophyton*) chemistry, the two species are quite distinct. The species, so far known only from the type specimen from Kolombangara Island, is named after the collector, David. J. Hill.



Figures 1-4. New species in the genus *Sclerophyton* from Australia and the Solomon Islands (holotypes x 12)

Fig. 1: *Sclerophyton conspicuum*; Fig. 2: *Sclerophyton hillii*; Fig. 3: *Sclerophyton insularum*; Fig. 4: *Sclerophyton maculatum*

Sclerophyton insularum A.W. Archer, *sp.nov.* Fig. 3

Similis *Sclerophyton rostratum* sed ascosporis majoribus differt.

Type: SOLOMON ISLANDS. Santa Isabel Island, Tanabuli Island, near Tatamba, *D.J. Hill 11022*, 29.ix.1965; holotype: BM.

Thallus crustose, discontinuous, off-white to pale fawn, corticolous, surface smooth and dull. *Ascomata* brown, punctiform, immersed, up to 0.5 mm diam., sometimes becoming up to 0.2 mm diam and united to form pseudo-lirellate ascomata, not aggregated in stroma-like structures. *Disc* brown epruinose. *Proper exciple* undifferentiated. *Hymenium* 200-240 μm tall. *Paraphyses* branched and anastomosing. *Asci* 160-180 x 20-30 μm, 8 spored. *Ascospores* narrow ellipsoid, tapering at one end, pale brown at maturity, hyaline when young, 44-54 μm long, 7-8 μm wide, 11-14 locular. *Pycnidia* not seen.

Chemistry: psoromic acid (major) and 2'-*O*-methylpsoromic acid (trace).

Also examined:
SOLOMON ISLANDS. Santa Isabel Island, Tanabuli Island, near Tatamba, *D.J. Hill 11030*, 29.ix.1965 (BM).

Sclerophyton insularum is characterised by initially punctiform ascomata which gradually become lirellate, the long asospores and the presence of psoromic acid. The species resembles the chemically similar *S. rostratum* but is distinguished from that species by the longer (44-54 μm) 11-14 locular ascospores as compared to 30-42 μm long, 6-8 locular ascospores in *S. rostratum*. The second specimen cited above (Hill 11030), collected on the same day at the same locality, has more markedly lirellate ascomata and less mature ascospores.

Sclerophyton maculatum A.W. Archer, *sp. nov.* Fig. 4

Similis *Sclerophyton elegans* sed ascosporis majoribus et acidum sticticum continens vice acidum psoromicum differt.

Type: SOLOMON ISLANDS. Kolombangara Island, 2 miles [3.2 km] up Kolombangara River, *D.J. Hill 10240*, 24.viii.1965; holotype: BM.

Thallus crustose, corticolous, pale olive green, surface smooth and subnitid. *Ascomata* lirellate, pale brown to brown, immersed, narrow, much branched, 1-3 mm long, 0.25-0.5 mm wide, aggregated in off-white, stroma-like structures, irregularly rounded, 2-8 x 1-4 mm. *Disc* orang to red brown. *Proper exciple* undifferentiated above, pale yellow brown below. *Hymenium* 80-100 μm tall. *Paraphyses* branched and anastomosing. *Asci* 60-70 x 10-16 μm, 8 spored. *Ascospores* fusiform, pale brown at maturity, hyaline when young, 36-42 μm long, 4-5 μm wide, 12-14 locular. Pycnidia not seen.

Chemistry: stictic acid (major) and cryptostictic acid (trace).

Sclerophyton maculatum is characterised by the narrow, branched, lirellate ascomata, immersed in stroma-like structures, the fusiform, pale brown ascospores and the presence of stictic acid. The lirellate ascomata resemble those of *S. elegans* (Makhija & Adawadkar 2002, Fig. 1A) but the ascospores are larger and possess more locules than those of *S. elegans* viz: 36-42 μm, 12-14 locules as compared with 17-21 μm, 4 locules in *S. elegans*.
The major lichen acid is stictic acid, as in the new species *S. hillii. Sclerophyton maculatum* is distinguished from the chemically similar *S. hillii,* by the larger ascospores in the former species.
The new species is so far known only from the type specimen from Kolombangara Island.

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CATALOGUE OF THE MYXOMYCETES FROM ARGENTINA

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Abstract

This contribution covers the Myxomycete species cited from Argentina until today. In this work 167 valid species are arranged within 32 genera and 8 families.

Keywords: Argentinean slime moulds, South American Myxomycota

Introduction

This work comprises the Myxomycete species recorded from Argentina up to the present. Original and detailed work by Digilio (1946) has been supplemented with later bibliographic data mentioned by Digilio (1950), Cocucci (1953), Horak (1966), Farr (1971), Arambarri (1971, 1972, 1973, 1975), Deschamps (1972, 1974, 1975, 1976a, b), Grosso (1981), Arambarri and Spinedi (1989) and Lugo and Crespo (2001). Furthermore, the studies by Fries (1903), Spegazzini (1880a, b, c, 1881, 1887, 1896a, b, 1898, 1909a b, 1912, 1913, 1916, 1926a, b) and Sturgis (1916) cited by Digilio (1946) have been reviewed.

Even though the studies by Deschamps (1975, 1976a, b) contain abundant information, the mentioned species are not accompanied by their corresponding bibliographical references. The present work attempts to fill this gap so as to provide information that can be useful for systematic research on the subject.

The families, as well as their genera and species, have been alphabetically ordered. The bibliographical data and the Provinces where the specimens were recorded are included for each species.

Martin and Alexopoulos's (1969) classification and nomenclatural system is adopted, as well as the synonymies accepted by these authors and Lado and Pando (1997, 1998), Lado et al. (1998) and Gams (2001).

The valid names are written in bold italic typeface and the synonyms in italic.

Fam. CERATIOMYXACEAE

CERATIOMYXA J. Schröt.

C. fruticulosa (O. F. Müll.) T. Macbr. Digilio, 1950: 389. Arambarri, 1971: 27; 1975: 10. Deschamps, 1976a: 147. Grosso 1981: 13. =*C. mucida* (Pers.) J. Schröt. Spegazzini, 1916: 260; 1926b: 416. **Provinces**: Buenos Aires, Córdoba, Jujuy, Misiones, Tierra del Fuego, Tucumán.

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Fam. CRIBRARIACEAE

CRIBRARIA Pers.

C. argillacea (Pers.) Pers. Arambarri, 1975: 14. **Provinces**: Tierra del Fuego.

C. aurantiaca Schrad. Arambarri, 1975: 13. **Provinces**: Tierra del Fuego.

C. cancellata (Batsch) Nann.-Bremek. =*Dictydium cancellatum* (Batsch) T. Macbr. Arambarri, 1975: 16. Deschamps, 1976a: 152. **Provinces**: Buenos Aires, Tierra del Fuego.

C. rutila (G. Lister) Nann.-Bremek. =*Dictydium rutilum* G. Lister. Arambarri, 1975: 17. **Provinces**: Tierra del Fuego.

C. tenella Schrad. Fries, 1903: 68. Deschamps, 1976a: 152. =*C. colossea* Speg. Spegazzini, 1909b: 258. **Provinces**: Chaco, Formosa, Jujuy.

C. violacea Rex. Arambarri, 1971: 132. Deschamps, 1976a: 152. **Provinces**: Buenos Aires.

C. vulgaris Schrad. Digilio, 1950: 400. Deschamps, 1976a: 152. **Provinces**: Tucumán.

LINDBLADIA Fr.

L. tubulina Fr. Deschamps, 1976a: 152. **Provinces**: Buenos Aires.

Fam. DIANEMATACEAE

CALOMYXA Nieuwl.

C. metallica (Berk.) Nieuwl. Arambarri & Spinedi, 1989: 5. **Provinces**: Antártida Argentina.

Fam. DIDYMIACEAE

DIDERMA Pers.

D. antarcticola Horak. Horak, 1966: 5. Deschamps, 1976b: 331. **Provinces**: Antártida Argentina.

D. antarcticum (Speg.) Sturgis. Arambarri, 1973: 181; 1975: 82. Deschamps, 1976b: 331. **Provinces**: Tierra del Fuego.

D. asteroides (Lister & G. Lister) G. Lister. Arambarri, 1975: 86. Deschamps, 1976b: 331. **Provinces**: Tierra del Fuego.

D. crustaceum Peck. Arambarri & Spinedi, 1989: 4. **Provinces**: Antártida Argentina.

D. effusum (Schwein.) Morgan. Arambarri, 1971: 76; 1975: 79. Deschamps, 1976b: 332. =*Chondrioderma reticulatum* (Rostaf.) Rostaf. Fries, 1903: 64. =*Physarum crustiforme* Speg. Spegazzini, 1898: 200. =*P. effusum* Schwein. Spegazzini, 1898: 199. **Provinces**: Buenos Aires, Jujuy, Tierra del Fuego, Tucumán.

D. fragilis Aramb. Arambarri, 1973: 175; 1975: 79. Deschamps, 1976b: 332. **Provinces**: Tierra del Fuego.

D. gigantocolumellae Farr. Farr, 1971: 634. Deschamps, 1976b: 332. **Provinces**: Tierra del Fuego.

D. globosum Pers. Deschamps, 1976b: 332. **Provinces**: Buenos Aires.

D. gracilis Aramb. Arambarri, 1973: 179; 1975: 84. Deschamps, 1976b: 333. **Provinces**: Tierra del Fuego.

D. hemisphaericum (Bull.) Hornem. Sturgis, 1916: 36. Deschamps, 1976b: 333. =*Chondrioderma michelii* (Lib.) Rostaf. Fries, 1903: 64. Spegazzini, 1926a: 153. **Provinces**: Buenos Aires, Córdoba, Jujuy.

D. niveum (Rostaf.) T. Macbr. Arambarri, 1975: 80. Deschamps, 1976b: 333. =*Chondrioderma niveum* Rostaf. Spegazzini, 1912 : 1. **Provinces**: Buenos Aires, Tierra del Fuego.

D. radiatum (L.) Morgan. Grosso, 1981: 29. **Provinces**: Córdoba.

D. robusta Aramb. Arambarri, 1973: 178; 1975: 84. Deshamps, 1976b: 333. **Provinces**: Tierra del Fuego.

D. spumarioides (Fr.) Fr. Deschamps, 1976b: 333. **Provinces**: Mendoza, Misiones.

D. subasteroides Farr. Farr, 1971: 637. Deschamps, 1976b: 334. **Provinces**: Buenos Aires, Río Negro.

D. trevelyani (Grev.) Fr. Arambarri, 1975: 85. Deschamps, 1976b: 334. =*Chondrioderma trevelyana* (Grev.) Rostaf. Fries, 1903: 64. **Provinces**: Salta, Tierra del Fuego.

DIDYMIUM Schrad.

D. anellus Morgan. Arambarri, 1971: 67. Deschamps, 1976b: 334. **Provinces**: Buenos Aires.

D. clavus (Alb. & Schwein.) Rabenh. Spegazzini, 1898: 201. Sturgis, 1916: 38. Digilio, 1950: 397. Arambarri, 1971: 68. Deschamps, 1976b: 334. **Provinces**: Buenos Aires, Tucumán.

D. difforme (Pers.) Gray. Deschamps, 1976b: 335. =*Chondrioderma difforme* (Pers.) Rostaf. Spegazzini, 1898: 201; 1916: 260. =*C. micraspis* Speg. Spegazzini, 1898: 200. **Provinces**: Buenos Aires, Tucumán.

D. dubium Rostaf. Deschamps, 1976b: 335. **Provinces**: Buenos Aires.

D. floccosum G. W. Martin, K. S. Thind & Rehill. Grosso, 1981: 28. **Provinces**: Córdoba.

D. intermedium J. Schröt. Deschamps, 1976b: 335. **Provinces**: Corrientes.

D. iridis (Ditmar) Fr. Arambarri, 1971: 74. Deschamps, 1976b: 335. =*D. nigripes* var. *xanthopus* (Ditmar) Lister. Fries, 1903: 65. **Provinces**: Buenos Aires, Tucumán.

D. melanospermum (Pers.) T. Macbr. Sturgis, 1916: 38. Arambarri, 1971: 72; 1975: 88. Deschamps, 1976b : 336. =*D. farinaceum* Schrad. Spegazzini, 1880b: 26; 1896b: 81. **Provinces**: Buenos Aires, Tierra del Fuego.

D. minus (Lister) Morgan. Deschamps, 1976b: 336. **Provinces**: Buenos Aires.

D. nigripes (Link) Fr. Fries, 1903: 65. Spegazzini, 1898: 201. Deschamps, 1976b: 336. **Provinces**: Buenos Aires, Jujuy, Tucumán.

D. perforatum Yamash. Deschamps, 1976b: 336. **Provinces**: Buenos Aires.

D. squamulosum (Alb. & Schwein.) Fr. Fries, 1903: 65. Spegazzini, 1898: 201; 1916: 261. Digilio, 1950: 397. Arambarri, 1971: 70. Deschamps, 1976b: 336. =*D. platense* Speg. Spegazzini, 1898: 201. **Provinces**: Buenos Aires, Jujuy, Misiones, Tucumán.

LEPIDODERMA de Bary

L. granuliferum (W. Phillips) R. E. Fr. Grosso, 1981: 26. **Provinces**: Córdoba.

MUCILAGO P. Micheli ex F. H. Wigg.

M. crustacea F. H. Wigg. Deschamps, 1976b: 334. Grosso, 1981: 27. =*Spumaria alba* (Bull.) DC. Spegazzini, 1926b: 418. **Provinces**: Buenos Aires, Córdoba.

Fam. PHYSARACEAE

BADHAMIA Berk.

B. affinis Rostaf. Deschamps, 1976b: 320. **Provinces**: Buenos Aires.

B. capsulifera (Bull.) Berk. Deschamps, 1976b: 320. =*B. hyalina* (Pers.) Berk. Spegazzini, 1887: 277. =*B. melanospora* Speg. Spegazzini, 1880c: 150. **Provinces**: Buenos Aires, Tierra del Fuego.

B. cinerascens G. W. Martín. Deschamps, 1976b: 320. **Provinces**: Buenos Aires.

B. foliicola Lister. Arambarri, 1971: 37. Deschamps, 1976b: 321. **Provinces**: Buenos Aires.

B. gracilis (T. Macbr.) T. Macbr. Deschamps, 1976b: 321. **Provinces**: Buenos Aires.

B. macrocarpa (Ces.) Rostaf. Deschamps, 1976b: 321. **Provinces**: Buenos Aires, Entre Ríos.

B. obovata (Peck) S. J. Sm. Deschamps, 1976b: 321. **Provinces**: Buenos Aires.

B. panicea (Fr.) Rostaf. Spegazzini, 1926a: 152. Sturgis, 1916: 35. Digilio, 1950: 391. Deschamps, 1976b: 322. **Provinces**: Buenos Aires, Córdoba, Tucumán.

B. versicolor Lister. Arambarri, 1975: 59. Deschamps, 1976b: 322. **Provinces**: Tierra del Fuego.

CIENKOWSKIA Rostaf.

C. reticulata (Alb. & Schwein.) Rostaf. Arambarri, 1975: 60. Deschamps, 1976b: 319. **Provinces**: Buenos Aires, Tierra del Fuego.

CRATERIUM Trentep.

C. aureum (Schumach.) Rostaf. Grosso, 1981: 18. **Provinces**: Córdoba.

C. leucocephalum (Pers.) Ditmar. Fries, 1903: 63. Arambarri, 1971: 39. Deschamps, 1976b: 323. **Provinces**: Buenos Aires, Salta.

C. paraguayense (Speg.) G. Lister. Arambarri, 1975: 58. Deschamps, 1976b: 323. **Provinces**: Tierra del Fuego, Tucumán.

FULIGO Haller

F. cinerea (Schwein.) Morgan. Arambarri, 1975: 56. Deschamps, 1976b: 322. Grosso, 1981: 14. **Provinces**: Córdoba, Corrientes, Tierra del Fuego.

F. megaspora Sturgis. Grosso, 1981: 16. **Provinces**: Córdoba.

F. septica (L.) F. H. Wigg. Fries, 1903: 63. Spegazzini, 1880a: 188; 1909b: 257; 1896a: 238; 1898: 200; 1916: 261. Digilio, 1950: 394. Arambarri, 1971: 33; 1975: 54. Deschamps, 1976b: 322. Grosso, 1981: 17. **Provinces**: Buenos Aires, Chaco, Córdoba, Entre Ríos, Jujuy, Misiones, Salta, Santiago del Estero, Tierra del Fuego, Tucumán.

LEOCARPUS Link

L. fragilis (Dicks.) Rostaf. Arambarri, 1975: 62. Deschamps, 1976b: 319. **Provinces**: Tierra del Fuego.

PHYSARELLA Peck

P. oblonga (Berk. & M. A. Curtis) Morgan. Sturgis, 1916: 36. Digilio, 1950: 394. Arambarri, 1971: 61. Deschamps, 1976b: 320. =*P. mirabilis* Peck. Spegazzini, 1909b: 257. **Provinces**: Buenos Aires, Tucumán.

P. oblonga (Berk. & M. A. Curtis) Morgan f. ***alba*** Alexop. Arambarri, 1971: 63. **Provinces**: Buenos Aires.

PHYSARUM Pers.

P. bethelii T. Macbr. ex Lister. Arambarri, 1975: 74. **Provinces**: Tierra del Fuego.

P. bivalve Pers. Spegazzini, 1926a: 152. Arambarri, 1975: 71. Deschamps, 1976b: 324. =*Leocarpus melaleucus* Mont. Spegazzini, 1881: 254. =*P. sinuosum* (Bull.) Weinm. Spegazzini, 1898: 199. **Provinces**: Buenos Aires, Córdoba, Tierra del Fuego.

P. bogoriense Racib. Fries, 1903: 61. Deschamps, 1976b: 324. **Provinces**: Jujuy.

P. cinereum (Batsch) Pers. Spegazzini, 1898: 200; 1912: 1; 1926a: 152. Digilio, 1950: 392. Arambarri, 1971: 59; 1975: 67. Deschamps, 1976b: 324. **Provinces**: Buenos Aires, Catamarca, Córdoba, Corrientes, Tierra del Fuego, Tucumán.

P. citrinum Schumach. Spegazzini, 1898: 199. Deschamps, 1976b: 325. **Provinces**: Buenos Aires.

P. compressum Alb. & Schwein. Fries, 1903: 61. Spegazzini, 1898: 198; 1916: 261; 1896a: 237. Arambarri, 1971: 57. Deschamps, 1976b: 325. **Provinces**: Buenos Aires, Jujuy, Misiones, Tucumán.

P. contextum (Pers.) Pers. Deschamps, 1976b: 325. **Provinces**: Buenos Aires.

P. diderma Rostaf. Spegazzini, 1912: 1; 1926a: 152. Arambarri, 1975: 71. Deschamps, 1976b: 326. Grosso, 1981: 20. **Provinces**: Catamarca, Córdoba, Tierra del Fuego.

P. didermoides (Pers.) Rostaf. Spegazzini, 1896a: 237; 1916: 261; 1926a: 152. Sturgis, 1916: 36. Digilio, 1950: 392. Arambarri, 1971: 51; 1975: 70. Deschamps, 1976b: 326. Grosso, 1981: 19. =*P. platense* Speg. Spegazzini, 1898: 199. **Provinces**: Buenos Aires, Córdoba, Corrientes, Tierra del Fuego, Tucumán.

P. galbeum Wingate. Grosso, 1981: 21. **Provinces**: Córdoba.

P. globuliferum (Bull.) Pers. Spegazzini, 1898: 198; 1926a: 152. Deschamps, 1976b: 326. =*P. delicatissimum* Speg. Spegazzini, 1898: 198. **Provinces**: Buenos Aires, Córdoba.

P. leucophaeum Fr. Spegazzini, 1880a: 187; 1898: 199. Deschamps, 1976b: 327. =*P. nutans* var. *leucophaeum* Lister. Spegazzini, 1912: 1. **Provinces**: Buenos Aires, Mendoza, Tucumán.

P. leucopus Link. Spegazzini, 1880c: 150; 1926a: 152. Digilio, 1950: 392. Arambarri, 1971: 44; 1975: 72. Deschamps, 1976b: 327. **Provinces**: Buenos Aires, Córdoba, Tierra del Fuego, Tucumán.

P. melleum (Berk. & Broome) Massee. Deschamps, 1976b: 327. =*P. tucumanense* Speg. Spegazzini, 1896a: 237; 1916: 261. **Provinces**: Tucumán.

P. mutabile (Rostaf.) G. Lister. Deschamps, 1976b: 327. **Provinces**: Buenos Aires.

P. notabile T. Macbr. Arambarri, 1975: 77. Deschamps, 1976b: 328. **Provinces**: Buenos Aires, Tierra del Fuego.

P. nucleatum Rex. Deschamps, 1976b: 328. Grosso, 1981: 22. **Provinces**: Buenos Aires, Córdoba.

P. nutans Pers. Spegazzini, 1912: 1; 1926a: 153. Digilio, 1950: 393. Cocucci, 1953: 3. Arambarri, 1971: 55. Deschamps, 1976b: 328. Grosso, 1981: 23. =*Tilmadoche nutans* (Pers.) Rostaf. Spegazzini, 1887: 277; 1898: 200. **Provinces**: Buenos Aires, Córdoba, Entre Ríos, Tierra del Fuego, Tucumán.

P. ovisporum G. Lister. Arambarri, 1971: 58. Deschamps, 1976b: 328. **Provinces**: Buenos Aires.

P. pezizoideum (Jungh.) Pavar.& Lagarde. Arambarri, 1971: 53. Deschamps, 1976b: 329. **Provinces**: Buenos Aires.

P. polycephalum Schwein. Sturgis, 1916: 35. Digilio, 1950: 393. Deschamps, 1976b: 329. =*Cribraria straminiformis* Speg. Spegazzini, 1880b: 26. =*Didymium gyrocephalum* Mont. Spegazzini, 1881: 255. =*Tilmadoche gyrocephala* (Mont.) Rostaf. Spegazzini, 1913: 182. **Provinces**: Buenos Aires, Entre Ríos, Jujuy, Misiones, Tucumán.

P. pusillum (Berk. & M. A. Curtis) G. Lister. Arambarri, 1971: 49. Deschamps, 1976b: 330. Grosso, 1981: 25. **Provinces**: Buenos Aires, Córdoba.

P. rigidum (G. Lister) G. Lister . Arambarri, 1971: 46. Deschamps, 1976b: 330. **Provinces**: Buenos Aires.

P. serpula Morgan. Arambarri, 1975: 68. **Provinces**: Tierra del Fuego.

P. sulphureum Alb. & Schwein. Deschamps, 1976b: 330. **Provinces**: Buenos Aires.

P. tenerum Rex. Deschamps, 1976b: 330. **Provinces**: Buenos Aires.

P. vernum Sommerf. Arambarri, 1975: 66. Deschamps, 1976b: 331. **Provinces**: Mendoza, Tierra del Fuego.

P. virescens Ditmar. Arambarri, 1975: 67. **Provinces**: Tierra del Fuego.

P. viride (Bull.) Pers. Fries, 1903: 60. Spegazzini, 1926a: 153. Arambarri, 1971: 47; 1975: 76. Deschamps, 1976b: 331. **Provinces**: Buenos Aires, Córdoba, Jujuy, Tierra del Fuego.

Fam. RETICULARIACEAE

DICTYDIAETHALIUM Rostaf.

D. plumbeum (Schumach.) Rostaf. Deschamps, 1976a: 149. Lugo & Crespo, 2001. =*Clathroptychium plumbeum* (Schmach.) Rostaf. Spegazzini, 1898: 203. **Provinces**: Buenos Aires, Córdoba, Jujuy.

LYCOGALA Adans.

L. epidendrum (L.) Fr. Spegazzini, 1880b: 26. Digilio, 1950: 401. Arambarri, 1971: 135; 1975: 22. Deschamps, 1976a: 149. Grosso, 1981: 30. Lugo & Crespo, 2001. =*L. miniatum* Pers. Spegazzini, 1926a: 153; 1926b: 418. =*L. platense* Speg. Spegazzini, 1898: 203. **Provinces**: Buenos Aires, Córdoba, Jujuy, Misiones, Tierra del Fuego, Tucumán.

L. flavofuscum (Ehrenb.) Rostaf. Spegazzini, 1926b: 418. Sturgis, 1916: 41. Deschamps, 1976a: 150. Grosso, 1981: 31. Lugo & Crespo, 2001. **Provinces**: Buenos Aires, Córdoba, Entre Ríos, Salta, Tucumán.

RETICULARIA Bull.

R. intermedia Nann.-Bremek. Deschamps, 1976a: 151. **Provinces**: Buenos Aires.

R. lycoperdon Bull. Spegazzini, 1881: 256; 1909b: 256; 1898: 203. Arambarri, 1971: 138; 1975: 24. Deschamps, 1976a: 151. =*Enteridium lycoperdon* (Bull.) Farr. Lugo & Crespo, 2001. **Provinces**: Buenos Aires, Córdoba, Jujuy, Tierra del Fuego.

R. olivacea (Ehrenb.) Fr. Arambarri, 1975: 25. Deschamps, 1976a: 151. =*Enteridium olivacium* Ehrenb. Spegazzini, 1881: 256; 1912: 2. **Provinces**: Buenos Aires, Mendoza, Tierra del Fuego.

TUBIFERA J. F. Gmel.

T. casparyi (Rostaf.) T. Macbr. Deschamps, 1976a: 148. **Provinces**: Entre Ríos.

T. ferruginosa (Batsch) J. F. Gmel. Arambarri, 1975: 20. Deschamps, 1976a: 148. **Provinces**: Buenos Aires, Tierra del Fuego.

T. microsperma (Berk. & M. A. Curtis) G. W. Martin. Deschamps, 1976a: 149. Lugo & Crespo, 2001. =*Tubulina stipitata* (Berk. & Ravenel) Rostaf. Fries, 1903: 68. Spegazzini, 1909b: 257. **Provinces**: Misiones, Salta, Santa Fe, Tucumán.

Fam. STEMONITACEAE

BREFELDIA Rostaf.

B. maxima (Fr.) Rostaf. Spegazzini, 1880a: 188; 1898: 202. Deschamps, 1976a: 163. **Provinces**: Buenos Aires, Tierra del Fuego.

COMATRICHA Preuss

C. argentina J. R. Deschamps. Deschamps, 1974: 340; 1976a: 168. **Provinces**: Buenos Aires.

C. caespitosa Sturgis. Deschamps, 1976a: 169. **Provinces**: Buenos Aires.

C. dictyospora L. F. _elak. Arambarri, 1975: 46. **Provinces**: Tierra del Fuego.

C. elegans (Racib.) G. Lister. Arambarri, 1975: 48. **Provinces**: Tierra del Fuego.

C. fluminensis (Speg.) Torrend. =*Stemonitis fluminensis* Speg. Spegazzini, 1898: 202. **Provinces**: Buenos Aires.

C. irregularis Rex. Deschamps, 1976a: 169. **Provinces**: Buenos Aires.

C. laxa Rostaf. Deschamps, 1976a: 169. Grosso, 1981: 43. **Provinces**: Buenos Aires, Córdoba.

C. longa Peck. Fries, 1903: 67. Deschamps, 1976a: 169. **Provinces**: Buenos Aires, Jujuy, Santa Fe.

C. nigra (Pers.) J. Schröt. Spegazzini, 1898: 201. Digilio, 1950: 399. Arambarri, 1971: 91; 1975: 47. Deschamps, 1976a: 170. =*C. friesiana* (de Bary) Rostaf. Spegazzini, 1880b: 25. **Provinces**: Buenos Aires, Río Negro, Tierra del Fuego, Tucumán.

C. pulchella (C. Bab.) Rostaf. Deschamps, 1976a: 170. **Provinces**: Buenos Aires.

C. rubens Lister. Spegazzini, 1912: 2. Deschamps, 1976a: 170. **Provinces**: Mendoza.

C. subcaespitosa Peck . Arambarri, 1971: 93. Deschamps, 1976a: 170. **Provinces**: Buenos Aires.

C. tenerrima (M. A. Curtis) G. Lister . Arambarri; 1971: 96. Deschamps, 1976a: 171. **Provinces**: Buenos Aires.

C. typhoides (Bull.) Rostaf. Spegazzini, 1909b: 257. Sturgis, 1916: 39. Arambarri, 1971: 94; 1975: 46. Deschamps, 1976a: 171. =*Stemonitis platensis* Speg. Spegazzini, 1898: 202. **Provinces**: Buenos Aires, Neuquén, Tierra del Fuego, Tucumán.

DIACHEA Fr.

D. leucopodia (Bull.) Rostaf. Spegazzini, 1898: 201. Sturgis, 1916: 38. Digilio, 1950: 395. Arambarri, 1971: 80. Deschamps, 1976a: 164. Grosso, 1981: 42. =*D. elegans* (Trentep.) Fr. Spegazzini, 1881: 255; 1909b: 257; 1916: 261; 1926b: 418. **Provinces**: Buenos Aires, Córdoba, Jujuy, Misiones, Salta, Tucumán.

ENERTHENEMA Bowman

E. papillatum (Pers.) Rostaf. Arambarri, 1975: 50. Deschamps, 1976a: 164. =*E. elegans* Bowman. Spegazzini, 1926b: 419. **Provinces**: Buenos Aires, Tierra del Fuego.

LAMPRODERMA Rostaf.

L. arcyrioides (Sommerf.) Rostaf. Arambarri, 1971: 99. Deschamps, 1976a: 168. =*L. violaceum* (Fr.) Rostaf. Spegazzini, 1909b: 257; 1926b: 419. **Provinces**: Buenos Aires.

L. arcyrionema Rostaf. Deschamps, 1976a: 168. **Provinces**: Buenos Aires.

LEPTODERMA G. Lister

L. megaspora Aramb. & Spinedi. Arambarri & Spinedi, 1989: 6. **Provinces**: Antártida Argentina.

STEMONITIS Roth

S. axifera (Bull.) T. Macbr. Deschamps, 1972: 142. Arambarri, 1975: 44. Deschamps, 1976a: 165. =*S. ferruginea* Ehrenb. Spegazzini, 1880b: 26; 1926a: 153; 1926b: 418. Digilio, 1950: 398. Deschamps (1972) analyzed this Digilio´s material and he identified it as ***Arcyria incarnata*** (Pers.) Pers. Cocucci, 1953: 3. **Provinces**: Buenos Aires, Córdoba, Entre Ríos, Jujuy, Río Negro, Tierra del Fuego, Tucumán.

S. confluens Cooke & Ellis. Deschamps, 1972: 143; 1976a: 165. **Provinces**: Buenos Aires.

S. flavogenita E. Jahn. Deschamps, 1972: 144; 1976a: 165. **Provinces**: Buenos Aires.

S. fusca Roth. Spegazzini, 1881: 255; 1898: 202; 1916: 261. Sturgis, 1916: 38. Digilio, 1950: 398. The 3 collections recorded by Digilio (1950) were studied by Deschamps (1972), who determined only one as ***S. fusca***, whereas the others were ***S. axifera*** and ***S. flavogenita***. Arambarri, 1971: 83. Deschamps, 1972: 145; 1976a: 166. Grosso, 1981: 45. **Provinces**: Buenos Aires, Córdoba, Entre Ríos, Jujuy, Salta, Tucumán.

S. herbatica Peck. Spegazzini, 1909b: 257. Sturgis, 1916: 39. Deschamps, 1972: 147; 1976a: 166. **Provinces**: Buenos Aires.

S. hyperopta Meyl. Deschamps, 1972: 147; 1976a: 166. **Provinces**: Buenos Aires.

S. inconspicua Nann.-Bremek. Arambarri, 1975: 41. **Provinces**: Tierra del Fuego.

S. microsperma Ing. Grosso, 1981: 46. **Provinces**: Córdoba.

S. nigrescens Rex. Arambarri, 1975: 42. **Provinces**: Tierra del Fuego.

S. pallida Wingate. Arambarri, 1971: 88. Deschamps, 1972: 148; 1976a: 167. =*S. carolinensis* T. Macbr. Deschamps, 1972: 143; 1976a: 165. **Provinces**: Buenos Aires, Mendoza.

S. smithii T. Macbr. Arambarri, 1971: 86. Deschamps, 1972: 149; 1976a: 167. **Provinces**: Buenos Aires.

S. splendens Rostaf. Fries, 1903: 66. Spegazzini, 1909b: 257. Sturgis, 1916: 39. Digilio, 1950: 398. Arambarri, 1971: 85; 1975: 42. Deschamps, 1972: 149; 1976a: 167. =*S. webberi* Rex. Deschamps, 1972: 152; 1976a: 168. **Provinces**: Buenos Aires, Catamarca, Córdoba, Jujuy, Salta, Tierra del Fuego, Tucumán.

S. virginiensis Rex. Deschamps, 1972: 151; 1976a: 167. **Provinces**: Buenos Aires.

Fam. TRICHIACEAE

ARCYRIA F. H. Wigg.

A. carnea (Bull.) Rostaf. Deschamps, 1976a: 154. **Provinces**: Buenos Aires, Tucumán.

A. cinerea (Bull.) Pers. Sturgis, 1916: 41. Digilio, 1950: 405. Arambarri, 1971: 110. Deschamps, 1976a: 154. Grosso, 1981: 35. =*A. albida* Pers. Spegazzini, 1909b: 258; 1912: 2. **Provinces**: Buenos Aires, Catamarca, Córdoba, Jujuy, Tucumán.

A. corymbosa Farr & G. W. Martín. Arambarri, 1975: 27. **Provinces**: Tierra del Fuego.

A. denudata (L.) Wettst. Digilio, 1950: 405. Arambarri, 1971: 113. Deschamps, 1976a: 155. Grosso, 1981: 38. =*A. punicea* Pers. Spegazzini, 1880b: 26; 1909b: 258; 1912: 2; 1916: 260; 1926a: 153; 1926b: 418. **Provinces**: Buenos Aires, Catamarca, Córdoba, Entre Ríos, Jujuy, Misiones, Tucumán.

A. ferruginea Saut. Spegazzini, 1909b: 258. Deschamps, 1976a: 156. =*A. bonariensis* Speg. Spegazzini, 1880c: 151. **Provinces**: Buenos Aires, Salta.

A. fuegiana Aramb. Arambarri, 1972: 154; 1975: 27. Deschamps, 1976a: 156. **Provinces**: Tierra del Fuego.

A. glauca Lister. Grosso, 1981: 36. **Provinces**: Córdoba.

A. incarnata (Pers.) Pers. Spegazzini, 1909a: 133; 1912: 2; 1926a: 153; 1926b: 418. Digilio, 1950: 405. Cocucci, 1953: 4. Arambarri, 1971: 116; 1975: 28. Deschamps, 1976a: 157. Grosso, 1981: 39. =*A. adnata* Rostaf. Spegazzini, 1881: 256; 1913: 182. **Provinces**: Buenos Aires, Catamarca, Córdoba, Misiones, Tierra del Fuego, Tucumán.

A. insignis Kalchbr. & Cooke. Fries, 1903: 69. Sturgis, 1916: 41. Arambarri, 1971: 112. Deschamps, 1976a: 157. **Provinces**: Buenos Aires, Jujuy, Río Negro.

A. nutans (Bull.) Grev. Digilio, 1950: 405. Deschamps, 1976a: 157. **Provinces**: Buenos Aires, Tucumán.

A. oerstedtii Rostaf. Digilio, 1950: 405. Arambarri, 1971: 115. Deschamps, 1976a: 158. **Provinces**: Buenos Aires, Tucumán.

A. pomiformis (Leers) Rostaf. Deschamps, 1976a: 158. Grosso, 1981: 37. **Provinces**: Buenos Aires, Córdoba.

A. versicolor W. Phillips. Spegazzini, 1909b: 258. Deschamps, 1976a: 158. **Provinces**: Buenos Aires, Salta.

HEMITRICHIA Rostaf.

H. abietina (Wigand) G. Lister. Arambarri, 1971: 121. Deschamps, 1976a: 160. Provinces: Buenos Aires.

H. clavata (Pers.) Rostaf. Fries, 1903: 69. Spegazzini, 1926a: 153. Digilio, 1950: 403. Arambarri, 1971: 124. Deschamps, 1976a: 160. Grosso, 1981: 40. Provinces: Buenos Aires, Córdoba, Jujuy, Misiones, Tucumán.

H. pusilla Speg. Spegazzini, 1881: 257. Deschamps, 1976a: 161. Provinces: Buenos Aires.

H. serpula (Scop.) Rostaf. Digilio, 1950: 404. Deschamps, 1976a: 161. Provinces: Buenos Aires, Jujuy, Tucumán.

H. stipitata (Massee) T. Macbr. Arambarri, 1971: 126. Deschamps, 1976a: 161. =*Hemiarcyria calyculata* Speg. Spegazzini, 1880c: 152; 1898: 203. Provinces: Buenos Aires, Tucumán.

METATRICHIA Ing

M. horrida Ing. Grosso, 1981: 32. Provinces: Córdoba.

M. vesparium (Batsch) Nann.-Bremek. Arambarri, 1971: 127. Deschamps, 1976a: 158. Grosso, 1981: 33. =*Hemitrichia vesparium* (Batsch) T. Macbr. Digilio, 1950: 404. Provinces: Buenos Aires, Córdoba, Entre Ríos, Jujuy, Tucumán.

OLIGONEMA Rostaf.

O. dancoii Aramb. & Spinedi. Arambarri & Spinedi, 1989: 3. Provinces: Antártida Argentina.

O. schweinitzii (Berk.) G. W. Martin. Deschamps, 1976a: 154. =*O. nitens* (Lib.) Rostaf. Spegazzini, 1913: 170. Provinces: Buenos Aires.

PERICHAENA Fr.

P. corticalis (Batsch) Rostaf. Arambarri, 1971: 105. Deschamps, 1976a: 153. =*P. populina* Fr. Spegazzini, 1909b: 258; 1912: 2. Provinces: Buenos Aires, Mendoza.

P. chrysosperma (Curr.) Lister. Deschamps, 1976a: 153. =*Cornuvia wrightii* (Berk. & M. A. Curtis) Rostaf. Spegazzini, 1898: 203. Provinces: Buenos Aires.

P. depressa Lib. Fries, 1903: 70. Arambarri, 1971: 107. Deschamps, 1976a: 153. Provinces: Buenos Aires, Jujuy, Misiones, Tucumán.

P. vermicularis (Schwein.) Rostaf. Arambarri, 1971: 103. Deschamps, 1976a: 154. Provinces: Buenos Aires.

TRICHIA Haller

T. antarctica Aramb. & Spinedi. Arambarri & Spinedi, 1989: 8. Provinces: Antártida Argentina.

T. botrytis (J. F. Gmel.) Pers. Digilio, 1950: 403. Deschamps, 1976a: 162. =*T. fragilis* (Sowerby) Rostaf. Spegazzini, 1887: 278. =*T. lorinseriana* Corda. Spegazzini, 1881: 257. Provinces: Buenos Aires, Chubut, Río Negro, Tierra del Fuego, Tucumán.

T. crateriformis G. W. Martín. Arambarri, 1975: 34. Provinces: Tierra del Fuego.

T. decipiens (Pers.) T. Macbr. Arambarri, 1975: 36. Deschamps, 1976a: 162. =*T. fallax* Pers. Spegazzini, 1887: 277. Provinces: Buenos Aires, Tierra del Fuego.

T. favoginea (Batsch) Pers. Arambarri, 1971: 119; 1975: 31. Deschamps, 1976a: 162. =*T. chrysosperma* (Bull.) Lam. & DC. Spegazzini, 1881: 257; 1916: 261. **Provinces**: Buenos Aires, Chubut, Jujuy, Misiones, Río Negro, Tierra del Fuego. Tucumán.

T. floriformis (Schwein.) G. Lister. Arambarri, 1975: 38. Deschamps, 1976a: 163. **Provinces**: Buenos Aires, Río Negro, Tierra del Fuego.

T. macbridei M. E. Peck. Arambarri, 1975: 32. **Provinces**: Tierra del Fuego.

T. scabra Rostaf. Grosso, 1981: 41. **Provinces**: Córdoba.

T. subfusca Rex. Deschamps, 1976a: 163. **Provinces**: Buenos Aires.

T. varia (Pers.) Pers. Spegazzini, 1880c: 152. Deschamps, 1976a: 163. **Provinces**: Buenos Aires, Río Negro.

T. verrucosa Berk. Arambarri, 1975: 32. **Provinces**: Tierra del Fuego.

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NOTES ON DAEDALEA ERUBESCENS, HEXAGONIA DECIPIENS AND THE PHAEOTRAMETACEAE

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Abstract: A new combination, *Gloeophyllum erubescens* based on *Daedalea erubescens,* and a new family name, Phaeotrametaceae based on *Phaeotrametes decipiens*, are proposed.

Key words: *Gloeophyllum, Phaeotrametes, Stiptophyllum*, Polypores, Aphyllophorales

During a current survey of the poroid and corticioid fungi from NE Argentina and Paraguay, a large number of specimens were found. Some of them are interesting and noteworthy. Several taxonomic problems arose during their study which need to be solved; two are discussed below.

1- *Daedalea erubescens* Berk.

Stiptophyllum Ryv. was founded (Ryvarden, 1973: 4) on *Daedalea erubescens* Berk., to separate this stipitate species from *Gloeophyllum* Karsten with sessile basidiocarps. In Ryvarden´s argument, the hyphal system, a feature traditionally considered with more phylogenetic significance, was demphasized in favour of macromorphology of the basidiocarp. To sustain his proposal he stressed the difference between *Microporus* Beauv. (pileate basidiocarps) and *Trametes* Fr. (sessile basidiocarps). Subsequently, Ryvarden (1991: 185) and Teixeira (1994: 66) underlined other characters in *Microporus*, such as the presence of a double context and coralloid elements at the border of the dissepiments; Ryvarden & Johansen (1980: 429) considered this last character variable and puzzling, but characteristic for the species of this genus.

On the other hand, Ryvarden (1991: 110 and 219), in observations on *Amylosporus* Ryv. and *Rigidoporiopsis* Johan. & Ryv., referring to works of David & Rajchenberg (1985, 1987) remarked: "The authors are joining the stipitate type species of *Amylosporus* with resupinate species previously placed in *Wrightoporia* Pouz. This is a radical step, as a stipitate type of basidiocarp has hitherto been looked upon rather as evolutionary advanced. For reasons stated in the chapter of morphology, I am not willing to accept such wide generic concept" "...In my opinion such a step (which totally neglects the type of basidiocarp as important character) is too radical and would consequently introduce too many undesirable changes in the nomenclature of the polypores."

Ryvarden (1991: 196) included *Polyporus veraecrucis* Berk. ex Sacc. in *Phylloporia* and argued "Macroscopically the type species of *Phylloporia* Murr. is resupinate. However, sessile to dimidiate basidiocarps are known in other species of the genus (see Ryvarden & Johansen, 1980: 230). I feel that the lateral prolongation of the pileus in *P. veraecrucis* should not exclude the species from *Phylloporia* when the microscopic characters otherwise suit so well".

Wright & Deschamps (1977: 49) proposed the combination *Xerotinus erubescens*, and mentioned that the species is dimitic, but described three types of hyphae, although they stated it is difficult to discern the true identity of the hyphal system and considered that this is similar to that found by Kauffman Fidalgo (1959) in *Xerotus afer* Fr.

It is necessary to point out that in Wright & Deschamps (1977: 50), a cultural study of *Xerotinus erubescens* is described (strain BAFC 474), a fact which seems to have been missed by other mycologists.

Ryvarden (1991: 226) when describing *Stiptophyllum*, states that there is no doubt that the genus is related to *Gloeophyllum*. Fidalgo (1958: 139), Pegler (1983: 11) and Teixeira (1994: 18) concurred, since both genera share the same hyphal system and have similar spores. Ryvarden (1991) also mentioned that the rot type is not known and that "the final solution to its generic assignment has to be postponed until that information becomes available". From the small pieces of wood attached to the specimens examined, he deduces that this species would cause a brown rot, as in *Gloeophyllum*. Wright & Deschamps (1977) earlier arrived at the same conclusion from the results of their cultural study.

For the above reasons a new combination is proposed as *Gloeophyllum erubescens* (Berk.) Popoff nov. comb., Basionym: *Daedalea erubescens* Berk., Ann. Mag. Nat. Hist. 4: 292. 1840.

Although it is not a common species, it is often found in northeastern Argentina and adjacent countries. It was previously recorded from Misiones (Argentina) as *Lentinus? fusco-ferrugineus* (Spegazzini, 1909), *Xerotinus erubescens* (Wright & Deschamps, 1977) and from Paraguay as *Stiptophyllum erubescens* (Popoff & Wright, 1998).

2- ***Hexagonia decipiens*** Berk.

Phaeotrametes decipiens (Berk.) Wright, is a polypore characterized by pigmented, thick-walled, truncated spores, poroid to daedaloid hymenophore which varies from brownish-lilac to brownish-isabelline, and a chlamydosporic fruitbody, which may be concrescent or not on the basidiomata.

Spegazzini (1880) described it as new species and named it *Polyporus perparadoxus*, transfering it successively to *Poria* Pers. (Spegazzini, 1888) and to *Polystictus* Fr. (Spegazzini, 1921). These names are considered synonyms of *Hexagonia decipiens* (*cf.* Wright, 1966).

Likewise, Cunningham (1950) described it as new species of *Trametes* (*T. drummondii*), but later (1965) considered it a species of *Osmoporus* Singer, describing it as *O. decipiens* with hyaline basidiospores that become pigmented when old or in the herbarium.

Ryvarden (1977) considered that the transfer made by Wright (1966) to a genus of it own (*Phaeotrametes*) a "sound disposition", because *Hexagonia decipiens* Berk. is "a highly characteristic species".

Wright (1966) remarks "The genus does not seem to have, as far as I know, any close relationship whatsoever with other known genera, and would appear isolated in any proposed system of classification of the polypores".

For the above-mentioned reasons, the family: Phaeotrametaceae fam. nov. is proposed.

Typus: *Phaeotrametes* Wright, Mycologia 58: 529. 1966.

Monotypic. It would conform, together with Perenniporiaceae Jülich, and Pachykytosporaceae Jülich, the order Perenniporiales Jülich. This author mentions (1981) a probable relationship of the Perenniporiales with Ganodermatales, which is verified later in molecular studies carried out by Hibbet & Donoghue (1995) and Boidin et al. (1998). The latter authors synonymize the order Ganodermatales Jul. with Perenniporiales Jul. including the Perenniporiaceae Jul. and Ganodermataceae Donk.

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EMENDATION OF ARCHAEOSPORA AND OF ITS TYPE SPECIES, ARCHAEOSPORA TRAPPEI

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ABSTRACT

A recent reclassification based on molecular findings and morphological characters placed *Acaulospora trappei* in the Archaeosporaceae. The emendations presented here reflect findings from a study of water-mounted spores of the type species of *Archaeospora*, *A. trappei*. A distinctive interior wall configuration, novel germination structure and dimorphism are reported.

KEYWORDS: Glomerales[1], dimorphism, germination

INTRODUCTION

The morphological characteristics of several species in the Acaulosporaceae (Morton & Benny, 1990) do not fit well with orb forming spores. Morton and Redecker (2001) found *Acaulospora trappei* R.N. Ames & Linderman to be ancestral to the Acaulosporaceae based on ribosomal DNA sequence, fatty acid profile and monoclonal antibody specificity. The absence of thin bi-layered inner walls indicated a distinct morphology that concorded with the molecular findings. Water-mounted spores of *Archaeospora trappei* (R.N. Ames & Linderman) J.B. Morton & Redecker revealed the presence of multiple inner walls and a germination structure. Small glomoid spores were also observed. This study illustrates the value of germination studies and observation of spores unaltered by mounting media.

MATERIALS AND METHODS

Spores from a pure culture of *Ar. trappei* in a Beltsville sand mixture (Millner & Kitt, 1992), stored for 5 years at 5° C, were used for the germination study. The dormant spores, recovered by wet sieving, were rinsed several times in distilled water or surface cleansed by rinsing several times with either a 1% or 5% solution of sodium hypochlorite and rinsed again with distilled water. Spores of uniform content were placed by capillary tube on micropore triangles overlaying a filter paper on either moistened sterilized or live soil in petri dishes and left to germinate at ambient temperature. Individual germinated spores were removed with a dissecting needle, placed in a water drop on a slide and covered with a 18 X 18 mm coverslip. The spore was rolled between the slide and coverslip by moving the coverslip with dissecting needles until the spore wall ruptured. Spores were examined and photographed in water alone or in water with a minute amount of dilute trypan blue stain giving a

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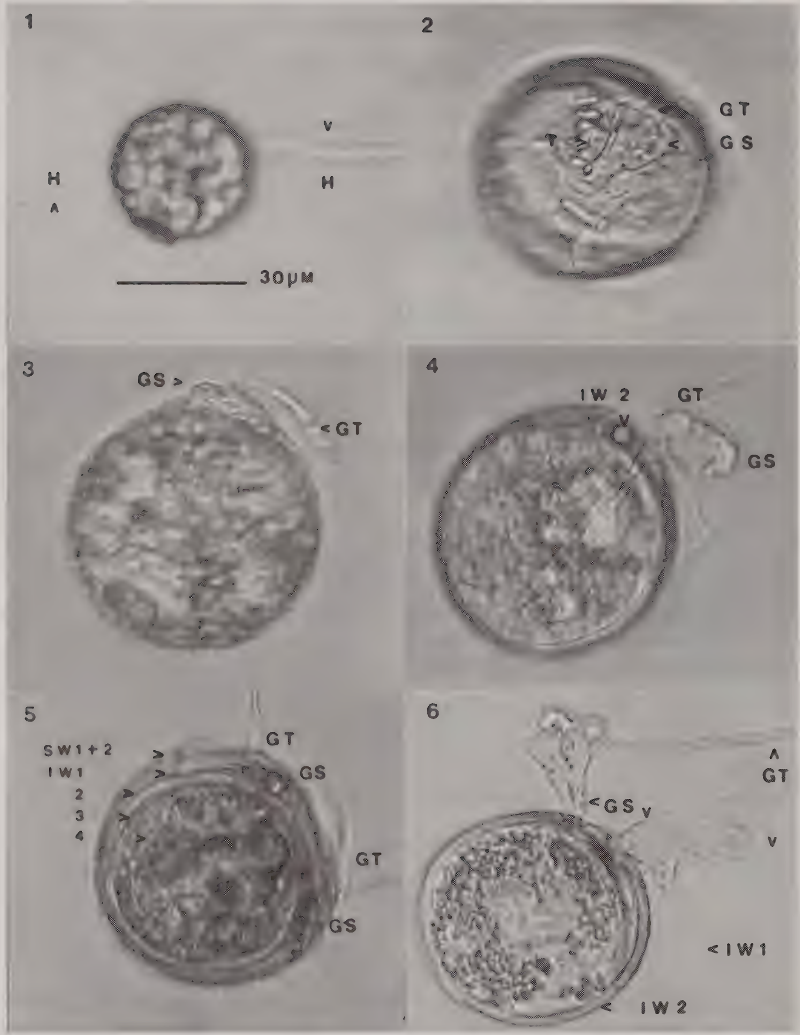
[1] The corrected spelling of this ordinal name is used here in place of the more familiar Glomales following Schussler et alii: A new fungal phylum, the Glomeromycota: phylogeny and evolution. Mycol. Res. 108: 1413-1421 (December 2001).


1
H
H
30µM
2
GT
T
GS
3
GS
GT
4
IW 2
GT
GS
5
SW1+2
IW1
2
3
4
GT
GS
GT
GS
6
GT
GS
IW1
IW 2

Figures 1-6. *Archaeospora trappei* in water with tinge of trypan blue. 1. Glomoid spore with attached hypha (H). 2. In situ: tube (T) with terminal germination structure (GS) with germ tube (GT); spore wall (SW, layers 1 & 2) removed . 3. Germination structure with germ tube; spore wall and inner wall 1 (IW1) ruptured. 4. Germiation structure attached by tube to inner wall 2 (IW2); tube appears truncated. 5. Spore wall and inner walls (IW 1, 2, 3 & 4); spore wall and inner wall one ruptured. 6. Bifurcate tube with two germination structures, each with a germ tube; spore wall and inner wall 1 ruptured.

barely perceptable tinge of blue. Walls of germinated spores, intact or ruptured but not crushed, were measured at 1000X. Dimorphism was observed in 4-8 month old pure cultures. Infected roots of *Zea mays* with attached mycelia were carefully removed for study from a Beltsville sand mixture which had been watered with modified half strength Hoagland's Solution.

Archaeospora trappei (R.N. Ames & Linderman) J.B. Morton & Redecker, *Mycologia* 93:183. 2001, emend. Spain Figs. 1-6

=*Acaulospora trappei* R.N. Ames & Linderman, *Mycotaxon* 3:566. 1976.

The appressed hyaline walls of a germinating spore, 0.5-1.5 μm thick, when ruptured in water reveal a somewhat wrinkled, semi-flexible spore wall of two layers and four inner walls. The outer layer of the spore wall, 0.5 μm thick, adheres to layer two, 1.0 μm thick, separating easily from the four inner walls: wall one, 0.5 μm thick; wall two, 1.5-2 μm. thick, possibly laminate; wall three, <0.5 μm thick; wall four, <0.5 μm thick, observed upon germination. Walls are non-reactive in Melzer's reagent.

Germination: Prior to germination, a single tube 2.0 μm diam. emerges from the second inner wall, elongates and develops an irregular germination structure between the first two inner walls. Occasionally the tube branches forming two germination structures each giving rise to a single germination tube which penetrates the spore wall. The tube remains attached to inner walls two, three and four.

Glomoid spores: Glomoid spores hyaline 22.5-31.25 μm in diam.; spore wall of two layers 1-1.5 μm thick. Intercalary and blastic formation occurred.

DISCUSSION

Ames and Linderman (1976) described *A. trappei* as having a single wall 1.2-2.3 μm thick. A redescription by Morton & Redecker (2001) placed *A. trappei* in Archaeosporaceae, fam. nov. with *Ar. trappei* as the type species. The revised taxonomy, based on the signature sequence within the 18S rDNA gene and the absence of bi-layered interior walls, distinguished it and the dimorphic species *Archaeospora leptoticha* (N.C. Schenck & G.S. Sm.) J.B. Morton & Redecker and *Archaeospora gerdemannii* (S.L. Rose, B. Daniels & Trappe) J.B. Morton & Redecker from all other fungi. The first and second thin inner walls of ruptured spores are not bi-layered as in the *Acaulospora* but are separated by a thick wall, which sometimes appears to be laminate when ruptured. Innermost thin wall four has only been observed in germinating spores.

Spores began to germinate after 10 days in plates with either sterile or nonsterile soil; surface cleaning with sodium hypochlorite at both concentrations reduced contamination by other organisms. Unlike orbs described for the Acaulosporaceae (Spain, 1992), the germination structure is formed at the terminus of an elongate tube emerging from inner wall two. When the spore wall is removed and the first thin inner wall ruptures the structure is no longer sandwiched between inner walls one and two, however, the tube remains attached to inner walls two, three and four. Usually one structure develops terminally on the tube, however, the tube may branch producing two structures, each giving rise to a single germination tube.

An occasional glomoid spore was observed in the gross examination of roots and hyphae; the cytoplasm appeared like that of the dormant acaulosporid spores. A single observation was made of terminally swollen hyphae branching from a germ tube, but it is not known whether these swellings were glomoid initials. Numerous observations were made of germinating spores without terminal swellings on branching hyphae. Inoculation with glomoid spores did not produce an infection in a single effort. Because of their small size, glomoid spores would not be recovered in the usual sieving procedure for *Ar. trappei.*

Diagnoses in the Acaulosporaceae have rarely documented germination and germination studies were not included for the species placed in Archaeosporaceae. Inner walls and germination structures are often missed in spores with altered morphology due to common mountants: lacto-phenol and polyvinyl alcohol-lactic acid –glycerol (PVLG). The difficulty studying spores in water mounts at high magnification is considerable, but key morphological features may be missed entirely if the effort is not made (Spain, 1990).

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REVISED NOMENCLATURE OF CORTINARIUS TAXA WITH TYPE SPECIMENS DEPOSITED IN THE INNSBRUCK (IB) MYCOLOGICAL HERBARIUM

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ABSTRACT

A nomenclatural study of the names associated with type collections deposited in the mycological collection of IB was undertaken. Many of these names were invalidly published (Art. 34.2.) or had never been officially recombined. Our Mycological Type Collection Database can now be searched on the world-wide-web, and thus we decided to validate or recombine the following 18 species epithets in *Cortinarius. Cortinarius alneus, C. atrocoeruleus, C. atropurpureus, C. betuletorum, C. caesiostramineus* var. *amarissimus, C. chrysophthalma, C. corynecystis, C. duramarus, C. fagetorum, C. flavotomentosus, C. heterochromus, C. multicolor, C. nothovenetus, C. obscurooliveus, C. obscurooliveus* var. *brunneus, C. olivipes, C. subtriumphans* var. *cephalixoides, C. viridipes*. We give an overview of the valid names of nomenclatural types regarded as synonyms and of nomenclatural types, which have already been recombined. Three names proposed in an earlier paper turned out to be later *Cortinarius* homonyms. Therefore, they are replaced by the new names *C. singerianus C. glabriceps* and *C. deminutus*.

INTRODUCTION

The mycological collection of the University of Innsbruck herbarium (IB) is very valuable: more than 600 type collections are deposited, among them about 400 type collections of *Cortinarius*. Most of these types were deposited by Meinhard M. Moser, one of the World's experts on Agaricales with special focus on the genus *Cortinarius*. The Internet address of the Mycological Type collection (IB) is http://orawww.uibk.ac.at/zid/j2ee/mkb/search.html. A nomenclatural study of the names associated with type collections deposited in the mycological collection of

IB was undertaken. Many of these names were invalidly published (Art. 34.2.) (Moser, 1953, 1957) or had never been officially recombined.

Moser (1960) initially regarded *Phlegmacium* (Fr.) Wünsche as a genus. Now it is considered as *Cortinarius* subgenus *Phlegmacium* Fr. 1836-1838 (Epicr.: 256). The status of *Dermocybe* (Fr.) Sacc. 1887 (Syll. Fung. 5: 935) was also debated for a long time (e.g. Ammirati, 1969, 1972, 1977, 1978; Moser 1972, 1973; Singer 1986). Molecular studies now demonstrated that *Dermocybe* is a subgenus of *Cortinarius* (Høiland & Holst-Jensen 2000, Liu et al. 1997; Peintner et al. 2001, 2002). However, many *Dermocybe* epithets have not yet been validly recombined in *Cortinarius* (e.g. Garnier 1991).

In summary, the here proposed new species, new names or new combinations became necessary due to the following articles of the International Code of Botanical Nomenclature (Saint Louis Code) (Greuter et al. 2000):

Art. 33.1. A combination (autonyms excepted) is not validly published unless the author definitely associates the final epithet with the name of the genus or species, or with its abbreviation.

Art. 33.3. A new combination, or an avowed substitute (replacement name, nomen novum), published on or after 1 January 1953 based on a previously and validly published name is not validly published unless its basionym is clearly indicated.

Art. 34.2. When on or after 1 January 1953, two or more different names based on the same type are proposed simultaneously for the same taxon by the same author (so-called alternative names), none of them is validly published. This rule does not apply in those cases where the same combination is simultaneously used at different ranks, either for infraspecific taxa within a species or for subdivisions of a genus within a genus.

Art. 36.1. On or after 1 January 1935 a name of a new taxon must, in order to be validly published, be accompanied by a Latin description or diagnosis or by a reference to a previously and effectively published Latin description or diagnosis. (Effective publication means publishing a name in such a way that a wide range of people have a reasonable shot at access to it.)

We propose the necessary 18 nomenclatural novelties. All new names and new combinations are indicated in boldface. The nomenclatural history of some types is complicated. Therefore, we provide an overview of the valid names of nomenclatural types preserved in our mycological collection, which are either regarded as synonyms or have already been recombined.

NEW NAMES, NEW COMBINATIONS AND ACCEPTED NAMES OF *CORTINARIUS* TYPES DEPOSITED IN THE MYCOLOGICAL COLLECTION IB

***Cortinarius alneus* M.M. Moser ex Kuhnert & Peintner spec. nov.**

Holotypus IB19510070, see Moser (1953) for the Latin description, *Cortinarius alneus* or *Hydrocybe alnea* M.M. Moser, Bulletin de la Société des Naturalistes d' Onyonnax 7:124 (1953) is a nom. inval. Art. 34.2.

***Cortinarius atrocoeruleus* M.M. Moser ex Kuhnert & Peintner spec. nov.**

Holotypus IB19510161, see Moser (1953) for the Latin description, *Cortinarius atrocoeruleus* or *Hydrocybe atrocoerulea* M.M. Moser, Bulletin de la Société des Naturalistes d' Onyonnax 7:126 (1953) is a nom. inval. Art. 34.2. All combinations based on this basionym are invalid as well: e.g. *Cortinarius decipiens* var. *atrocoeruleus* (M.M. Moser) Lindström, in *Cortinarius* (ed. Brandrud T.E., Lindström H., Marklund H., Melot J., Muskos S.), Flora Photographica (4):20 (1998).

***Cortinarius atropurpureus* (E. Horak) Kuhnert & Peintner comb. nov.**
Basionym: *Dermocybe atropurpurea* E. Horak, Beihefte zur Nova Hedwigia 52:481 (1975).

***Cortinarius betuletorum* M.M. Moser ex Kuhnert & Peintner spec. nov.**
Holotypus IB19510147, see Moser (1957) for the Latin description, *Hydrocybe betuletorum* or *Cortinarius betuletorum* M.M. Moser, Sydowia Beiheft I:235 (1957) is a nom. inval. Art. 34.2.

***Cortinarius caesiostramineus* Rob. Henry var. *amarissimus* (M.M. Moser) Kuhnert & Peintner comb. nov.**
Basionym: *Phlegmacium caesiostramineum* (Rob. Henry) M.M. Moser var. *amarissimum* M.M. Moser, Die Gattung *Phlegmacium*. In: Die Pilze Mitteleuropas. Bd.IV. (Verlag Julius Klinkhard, Bad Heilbrunn):355 (1960).

***Cortinarius chrysophthalma* (M.M. Moser) Kuhnert & Peintner comb. nov.**
Basionym: *Dermocybe chrysophthalma* M.M. Moser, Beihefte zur Nova Hedwigia 52:494 (1975).

***Cortinarius corynecystis* (M.M. Moser) Kuhnert & Peintner comb. nov.**
Basionym: *Dermocybe corynecystis* M.M. Moser, Beihefte zur Nova Hedwigia 52:499 (1975).

***Cortinarius duramarus* Jul. Schäff. in M.M. Moser ex Kuhnert & Peintner spec. nov.**
Holotypus IB19490159, see Moser (1957) for the Latin description, *Cortinarius duramarus* or *Myxacium duramarum* Jul. Schäff. in M.M. Moser, Sydowia Beiheft I:227 (1957) is a nom. inval. Art. 34.2.

***Cortinarius fagetorum* M.M. Moser ex Kuhnert & Peintner spec. nov.**
Holotypus IB19480743, see Moser (1957) for the Latin description, *Hydrocybe fagetorum* or *Cortinarius fagetorum* M.M. Moser, Sydowia Beiheft I:239 (1957) is a nom. inval. Art. 34.2.

***Cortinarius flavotomentosus* (M.M. Moser) Kuhnert & Peintner comb. nov.**
Basionym: *Dermocybe flavotomentosa* M.M. Moser, Beihefte zur Nova Hedwigia 52:478 (1975).

***Cortinarius heterochromus* (M.M. Moser) Kuhnert & Peintner comb. nov.**
Basionym: *Dermocybe heterochroma* M.M. Moser, Beihefte zur Nova Hedwigia 52:487 (1975).

***Cortinarius multicolor* M.M. Moser ex Kuhnert & Peintner spec. nov.**
Holotypus IB19480696, see Moser (1953) for the Latin description, *Hydrocybe multicolor* or *Cortinarius multicolor* M.M. Moser, Bulletin de la Société des Naturalistes d' Onyonnax 7:127 (1953) is a nom. inval. Art. 34.2.

***Cortinarius nothovenetus* (M.M. Moser) Kuhnert & Peintner comb. nov.**
Basionym: *Dermocybe nothoveneta* M.M. Moser, Beihefte zur Nova Hedwigia 52:491 (1975).

***Cortinarius obscurooliveus* (M.M. Moser) Kuhnert & Peintner comb. nov.**
Basionym: *Dermocybe obscuroolivea* M.M. Moser, Beihefte zur Nova Hedwigia 52:507 (1975).

***Cortinarius obscurooliveus* (M.M. Moser) Kuhnert & Peintner var. *brunneus* (M.M. Moser) Kuhnert & Peintner comb. nov.**
Basionym: *Dermocybe obscuroolivea* M.M. Moser var. *brunnea* M.M. Moser, Beihefte zur Nova Hedwigia 52:509 (1975).

***Cortinarius olivipes* (M.M. Moser) Kuhnert & Peintner comb. nov.**
Basionym: *Dermocybe olivipes* M.M. Moser, Beihefte zur Nova Hedwigia 52:506 (1975).

***Cortinarius subtriumphans* Rob. Henry var. *cephalixoides* (M.M. Moser) Kuhnert & Peintner comb. nov.**
Basionym: *Phlegmacium subtriumphans* (Rob. Henry) M.M. Moser var. *cephalixoides* M.M. Moser, Die Gattung Phlegmacium. In: Die Pilze Mitteleuropas. Bd.IV. (Verlag Julius Klinkhard, Bad Heilbrunn):352 (1960).

***Cortinarius viridipes* M.M. Moser ex Kuhnert & Peintner spec. nov.**
Holotypus IB19490039, see Moser (1957) for the Latin description, *Hydrocybe viridipes* or *Cortinarius viridipes* M.M. Moser, Sydowia Beiheft I:238 (1957) is a nom. inval. Art. 34.2.

Valid names of nomenclatural types regarded as synonyms or of nomenclatural types which have already been recombined

Cortinarius canabarba M.M. Moser Carinthia II, Mitteilungen des Naturwissenschaftlichen Vereins für Kärnten 76:30 (1966) (Synonym).
Valid name: *Cortinarius umidicola* Kauffman, Bulletin of the Torrey Botanical Club 32:322 (1905).

Cortinarius cedriolens or *Hydrocybe cedriolens* M.M. Moser, Bulletin de la Société des Naturalistes d' Onyonnax 7:125 (1953) nom. inval. Art. 34.2.
Valid name:*Cortinarius parvannulatus* Kühner, Bulletin de la Société Linnéenne de Lyon 24(2):40 (1955).

Cortinarius ceraceus or *Hydrocybe ceracea* M.M. Moser, Sydowia Beiheft I:236 (1957) nom. inval. Art. 34.2.
Valid name: *Cortinarius detonsus* Fr. Epicr.:313(1838)

Cortinarius palustris or *Hydrocybe palustris* M.M. Moser, Bulletin de la Société des Naturalistes d' Onyonnax 7:123 (1953) nom. inval. Art. 34.2.
Valid name: *Cortinarius huronensis* Ammirati & A.H. Sm., Michigan Botanist 11:20 (1972)
Notes: *Cortinarius huronensis* is probably a later synonym of *Cortinarius chrysolithus* Kauffman, New York State Mus. Bull. 179:101 (1914). In this case, *Cortinarius chrysolithus* would be the valid, older name.

Cortinarius strobilaceus M.M. Moser, Nova Hedwigia 14:516 (1967) (Synonym).
Valid name: *Cortinarius angelesianus* A.H. Sm., Lloydia 7:205 (1944).

Cortinarius tigrinus or *Hydrocybe tigrina* M.M. Moser, Bulletin de la Société des Naturalistes d' Onyonnax 7:122 (1953) nom. inval. Art. 34.2.
Valid name: *Cortinarius fuscoperonatus* Kühner, Bulletin de la Société Linnéenne de Lyon 24 (2):39 (1955).

Dermocybe alcalisensibilis M.M. Moser, Beihefte zur Nova Hedwigia 52:511 (1975) (Basionym).
Valid name: *Cortinarius alcalisensibilis* (M.M. Moser) G. Garnier, Bibliographie des Cortinaires A-C:17 (1991).

Dermocybe amoena M.M. Moser & E. Horak, Beihefte zur Nova Hedwigia 52:486 (1975) (Basionym).
Valid name: *Cortinarius amoenus* (M.M. Moser & E. Horak) E. Valenz. & G. Moreno, Boletín Micológico, Valparaíso 12(1-2):116 (1997).
Synonym: *Dermocybe hypoxantha* Horak, Beihefte zur Nova Hedwigia 52:510 (1975).

Dermocybe austronanceiensis M.M. Moser, Beihefte zur Nova Hedwigia 52:489 (1975) (Basionym).
Valid name: *Cortinarius austronanceiensis* (M.M. Moser) G. Garnier Bibliographie des Cortinaires:57 (1991).

Dermocybe bataillei Favre ex M.M. Moser, Schweizerische Zeitschrift für Pilzkunde 54:147 (1976) (Basionym).
Valid name: *Cortinarius bataillei* (Favre ex M.M. Moser) Høiland, Opera Botanica 71:86 (1984)[1983].

Dermocybe cinnamomeolutea (Orton) M.M. Moser var. *porphyreovelata* M.M. Moser, Schweizerische Zeitschrift für Pilzkunde 51:140 (1973) (Synonym).
Valid name: *Cortinarius croceus* (Schaeff.) Gray, Nat. Arr. Brit. Pl. I: 630 (1821).

Dermocybe cistoadelpha G. Moreno, Pöder, Kirchmair, Esteve-Raventós & Heykoop, Mycotaxon 62:240 (1997) (Basionym).
Valid name: *Cortinarius cistoadelphus* (G. Moreno, Pöder, Kirchmair, Esteve-Raventós & Heykoop) G. Moreno, Sociedad Micológica Extremena 8:47 (1997).

Dermocybe flavofucata E. Horak & M.M. Moser, Beihefte zur Nova Hedwigia 52:503 (1975) (Basionym).
Valid name: *Cortinarius flavofucatus* (E. Horak & M.M. Moser) E. Valenz. & G. Moreno, Boletín Micológico, Valparaíso 12(1-2):116 (1997).

Dermocybe holoxantha I. Gruber & M.M. Moser, Zeitschrift für Pilzkunde 35:75 (1969) (Basionym).
Valid name: *Cortinarius holoxanthus* (I. Gruber & M.M. Moser) Nezdojm., Akad. nauk SSSR Nov. Sist. Niz. Rast. 17:54 (1980).

Dermocybe icterina E. Horak, Beihefte zur Nova Hedwigia 52:484 (1975) (Basionym).
Valid name: *Cortinarius icterinus* (E. Horak) G. Moreno & E. Valenz (1997) Boletín Micológico, Valparaíso 12(1-2):116 (1997).

Dermocybe luteostriatula M.M. Moser & E. Horak, Beihefte zur Nova Hedwigia 52:501 (1975) (Basionym).
Valid name: *Cortinarius luteostriatulus* (M.M. Moser & E. Horak) E. Valenz. & G. Moreno, Boletín de la Sociedad Micológica de Madrid 19:289 (1994).

Dermocybe olivaceobubalina M.M. Moser, Beihefte zur Nova Hedwigia 52:496 (1975) (Basionym).
Valid name: *Cortinarius olivaceobubalinus* (M.M. Moser) E. Valenz. & G. Moreno, Boletín de la Sociedad Micológica de Madrid 19:289 (1994).

Dermocybe oliveoicterina M.M. Moser, Beihefte zur Nova Hedwigia 52:492 (1975) (Basionym).
Valid name: *Cortinarius oliveoicterinus* (M.M. Moser) E. Valenz. & G. Moreno, Boletín Micológico, Valparaíso 12(1-2):116 (1997).

Dermocybe saligna M.M. Moser & Keller, Zeitschrift für Pilzkunde 43:211 (1977) (Synonym).
Valid name: *Cortinarius cinnamomeoluteus* Orton, Transactions of the British mycological Society 43:217 (1960).

Dermocybe sanguinea (Wulf.: Fr.) Wünsche var. *vitiosa* M.M. Moser, Schweizerische Zeitschrift für Pilzkunde 54:148 (1976) (Synonym).
Valid name: *Cortinarius phoeniceus* Maire, Bulletin du Societé Mycologique de France 27:434 (1911).

Dermocybe semipellucida M.M. Moser, Beihefte zur Nova Hedwigia 52:497 1975 (Basionym).
Valid name: *Cortinarius semipellucidus* (M.M. Moser) G. Moreno & E. Valenz., Boletín Micológico, Valparaíso 12(1-2):118 (1997).

Dermocybe sphagnogena M.M. Moser, Schweizerische Zeitschrift für Pilzkunde 51:134 (1973) (Synonym).
Valid name: *Cortinarius tubarius* Ammirati & A.H Sm., Michigan Botanist 11:22 (1972).

Phlegmacium arquatum Fr. var. *haasii* M.M. Moser, Die Gattung *Phlegmacium*. In: Die Pilze Mitteleuropas. Bd.IV. (Verlag Julius Klinkhard, Bad Heilbrunn):353 (1960) (Basionym).
Valid name: *Cortinarius haasii* (M.M. Moser) M.M. Moser, Die Röhrlinge und Blätterpilze (Agaricales). In: Gams H. Kleine Kryptogamenflora Bd.II b/2, 3. Aufl., Gustav Fischer Verlag (Stuttgart):294 (1967).
Synonym: *Cortinarius calochrous* var. *haasii* (M.M. Moser) Brandrud, in Brandrud & Melot, Nordic J. Bot. 10(5):536 (1990).

Phlegmacium elegantior (Fr.) Wünsche var. *volvatum* M.M. Moser, Die Gattung *Phlegmacium* In: Die Pilze Mitteleuropas. Bd.IV. (Verlag Julius Klinkhard, Bad Heilbrunn):360 (1960) (Basionym).
Valid name:*Cortinarius elegantior* Fr. f. *volvatus* (M.M. Moser) Quadr., Documents Mycologiques 14(56):29 (1985).
Synonym: *Cortinarius elegantiovolvatus* M.M. Moser, Sydowia VI:145 (1952) nom. prov.

NOMENCLATURAL CORRECTIONS

Two in Peintner et al. (2002c) newly proposed names (*Cortinarius hygrophilus* Peintner & M.M. Moser, *C. lubricus* Peintner & M.M. Moser) and one new combination (*C. redactus* (G. W. Beaton, Pegler & T. W. K. Young) Peintner & M.M. Moser) turned out to be later homonyms. Therefore they are replaced by:

***Cortinarius singerianus* Peintner nom. nov.** Basionym: *Thaxterogaster bibulum* Singer (1969), Beihefte zur Nova Hedwigia 29:361; ut *Thaxterogaster bibulus.* non *Cortinarius bibulus* Quél. (1881).

The in Peintner et al. (2002c) proposed new name *Cortinarius hygrophilus* Peintner & M.M. Moser (2002) is a later homonym **of *Cortinarius hygrophilus*** Bidaud, Fillion & Moënne-Locc. (1999).

***Cortinarius glabriceps* Peintner nom. nov.** Basionym: *Thaxterogaster lubricum* M.M. Moser (1965), Nova Hedwigia X, 226. non *Cortinarius lubricus* Poirier & Reumaux (1999). *Cortinarius lubricus* Peintner & M.M. Moser (2002) is a later invalid homonym.

***Cortinarius deminutus* Peintner nom. nov.** Basionym: *Thaxterogaster redactus* G.W. Beaton, Pegler & T. W. K. Young (1985), Kew Bulletin 40(1):177. non *Cortinarius redactus* Britzelm. (1899). *Cortinarius redactus* (G. W. Beaton, Pegler & T. W. K. Young) Peintner & M.M. Moser (2002) is a later invalid homonym.

In Peintner et al. (2002b) G. Marie Taylor (1930-1999) should have been cited as G.M. Taylor, not as M.W. Taylor:

Cortinarius achrous E. Horak, Peintner, M.M. Moser & Vilgalys. Basionym: *Rozites pallida* E. Horak & G.M. Taylor (1981): New Zealand Journal of Botany 19:356.

Cortinarius elacatipus E. Horak, Peintner, M.M. Moser & Vilgalys. Basionym: *Rozites fusipes* E. Horak & G.M. Taylor (1981): New Zealand Journal of Botany Bot 19:356.

Cortinarius meleagris (E. Horak & M.W. Taylor) E. Horak, Peintner, M.M. Moser & Vilgalys. Basionym: *Rozites meleagris* E. Horak & G.M. Taylor (1981): New Zealand Journal of Botany Bot 19:354.

Cortinarius rugosiceps (E. Horak & M.W. Taylor) Peintner, E. Horak, M.M. Moser & Vilgalys. Basionym: *Rozites rugosiceps* E. Horak & G.M. Taylor (1981): New Zealand Journal of Botany Bot 19:357.

Cortinarius subcastanella E. Horak, Peintner, M.M. Moser & Vilgalys. Basionym: *Rozites castanella* E. Horak & G.M. Taylor (1981): New Zealand Journal of Botany Bot 19:358.

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ERYSIPHE AZALEAE AND ERYSIPHE SYRINGAE-JAPONICAE INTRODUCED IN POLAND

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ABSTRACT: The following two powdery mildews new for Poland are discussed: *Erysiphe azaleae* on *Rhododendron luteum* and *Erysiphe syringae-japonicae* on *Syringa* × *chinensis*, *Syringa* × *persica* var. *integrifolia*, *S.* × *prestoniae* 'Octavia', *S. tomentella* and *S. vulgaris*. *Syringa* × *persica* var. *integrifolia* and *Syringa* × *prestoniae* are new host species for *Erysiphe syringae-japonicae*.

KEY WORDS: Erysiphales, host range, *Rhododendron*, *Syringa*, Europe

INTRODUCTION

The powdery mildew fungi of Poland are relatively well-known thanks to the monograph of Sałata (1985) supplemented by further reports of other authors (e.g., Mułenko 1993, 1994; Wołczańska 1995; Dynowska *et al.* 1999; Ruszkiewicz 2000; Adamska 2001; Czerniawska 2001; Wołczańska & Oklejewicz 2001; Piątek 2000, 2002; Wołczańska & Mułenko 2002). Nonetheless, it is still possible to find rare and unusual Erysiphales in this country. Recent collections of these fungi from southern Poland revealed some specimens of *Erysiphe azaleae* (U. Braun) U. Braun & S. Takamatsu and *Erysiphe syringae-japonicae* (U. Braun) U. Braun & S. Takamatsu, species originating from North America and East Asia, respectively. To date these fungi have not yet been reported from Poland, although on azaleas and rhododendrons a powdery mildew anamorph is known (Łabanowski & Orlikowski 1997) and on lilacs numerous findings of the anamorph and teleomorph of *Erysiphe syringae* Schwein. have been recorded (Wołczańska & Mułenko 2002).

DESCRIPTION AND DISCUSSION

1. *Erysiphe azaleae* (U. Braun), U. Braun & S. Takamatsu, Schlechtendalia **4**: 5. 2000. – *Microsphaera azaleae* U. Braun, Mycotaxon **14**(1): 370. 1982.

Mycelium on leaves, amphigenous, whitish to pale grey, rather persistent, forming small patches. Cleistothecia usually hypophyllous, gregarious, brownish, 104–125(–156) µm diam., cells irregularly polygonal; appendages very numerous, equatorial, hyaline, 100–150 µm long, aseptate or with one septum at the base, thin-walled, thick-walled toward the base, apex 4-6 times regularly branched, with recurved tips. Asci 4–9, sessile or short-stalked, 40–60 × 30–45 µm; ascospores 4–6(–7) per ascus, ellipsoid or slightly ovoid, hyaline, 16–26 × 10–13 µm.

On *Rhododendron luteum* Sweet, Poland, Prov. Małopolska, Kraków, Botanical Garden, 22 Oct. 2002, leg. M. Piątek (KRAM F-52680), 23 Oct. 2002, leg. M. Piątek (KRAM F-52681).

Erysiphe azaleae was originally described as *Microsphaera azaleae* by Braun (1982a) based on a North American collection of infected leaves of *Rhododendron nudiflorum* (L.) Torr. This powdery mildew now belongs in *Erysiphe* sect. *Microsphaera* (Lév.) U. Braun & N. Shishkoff, according to the new concept of the genus *Erysiphe* DC. emend. U. Braun & S. Takamatsu (Braun & Takamatsu 2000). *Erysiphe azaleae* is easily distinguishable from any other powdery mildews on azaleas and rhododendrons by having large cleistothecia with very numerous appendages.

Erysiphe azaleae is a native North American powdery mildew on *Rhododendron nudiflorum* and *Rhododendron* sp. (Braun 1987), introduced in Europe on various *Rhododendron* species. At first only the anamorph was found, which could not be properly identified; for instance, Watling (1985) listed a number of powdery mildew anamorphs on *Rhododendron* and *Erica* L. species, and Braun (1987) regarded this anamorph simply as *Oidium ericinum* Erikss. Recently, the anamorph as well as teleomorph of *E. azaleae* has been found on *Erica gracilis* Salisb. in Germany (U. Braun, *in litt.*), suggesting that Braun's (1987) treatment was correct, so that *Oidium ericinum* has to be considered the anamorph of *E. azaleae*. Łabanowski and Orlikowski (1997) considered an anamorphic powdery mildew from Poland, observed on azaleas and rhododendrons cultivated both indoors and outdoors, to be '*Microsphaera penicillata*'.

The first record of the teleomorph of *Erysiphe azaleae* in Europe is from Bonn in Germany (Braun 1997; Inman *et al.* 2000). A collection from this locality from 1996 was distributed in ‘Microfungi exsiccati’ as 'No. 197' issued by D. Triebel, Botanische Staatssammlung, München, Germany. Later the teleomorph was also found in Switzerland (Inman *et al.* 2000) and England (Ing 2000). Poland is the fourth European country in which *Erysiphe azaleae* has been detected. The Polish finding derives from a large colony of *Rhododendron luteum* Sweet cultivated in the Botanical Garden in Kraków. The host was moderately infected by this powdery mildew. Only the anamorph occurred on the majority of individuals, but cleistothecia were found on single shrubs. The locality in Poland indicates that the fungus is spreading eastwards in Europe.

2. *Erysiphe syringae-japonicae* (U. Braun) U. Braun & S. Takamatsu, Schlechtendalia **4**: 14. 2000. – *Microsphaera syringae-japonicae* U. Braun, Mycotaxon **15**: 121. 1982.

Mycelium on leaves, amphigenous, whitish to pale grey, evanescent, effuse, but sometimes forming only small patches. Cleistothecia mostly hypophyllous, but also epiphyllous, brownish, 94–125 µm diam., cells polygonal to rounded, 10–25 µm diam.; appendages equatorial, 83–125 µm long, aseptate, brown at the base, becoming lighter up to the middle of the stalk, thick-walled throughout, apex 4-6 times dichotomously regularly branched, with recurved tips. Asci 3–10, sessile or short-stalked, 50–60 × 35–40 µm, (5–)7–8-spored; ascospores ellipsoid, hyaline, 18.5–20.0(–23.0) × 9.5–12.5 µm.

On *Syringa* × *chinensis* Willd., Poland, Prov. Małopolska, Kraków, Botanical Garden, 15 Oct. 2002, leg. J. Cabała & M. Piątek (KRAM F-52740).

On *Syringa* × *persica* L. var. *integrifolia* L., Poland, Prov. Małopolska, Kraków, Botanical Garden, 23 Oct. 2002, leg. M. Piątek (KRAM F-52736).

On *Syringa* × *prestoniae* McKelvey ‘Octavia’, Poland, Prov. Małopolska, Kraków, Botanical Garden, 15 Oct. 2002, leg. J. Cabała & M. Piątek (KRAM F-52688).

On *Syringa tomentella* Bureau & Franch., Poland, Prov. Małopolska, Kraków, Botanical Garden, 16 Oct. 2002, leg. J. Cabała & M. Piątek (KRAM F-52737).

On *Syringa vulgaris* L., Poland, Prov. Małopolska, Tarnów, Osiedle Zielone, July 1998, leg. M. Piątek (KRAM F-52738); Kraków, Planty near J. Słowacki Theatre, Oct. 2002, leg. M. Piątek (KRAM F-52739); Botanical Garden, 15 Oct. 2002, leg. J. Cabała & M. Piątek (KRAM F-52741).

Braun (1982b) described this species as *Microsphaera syringae-japonicae* from leaves of *Syringa amurensis* Rupr. var. *japonica* (Maxim). Franch. & Sav. [= *S. reticulata* (Blume) Hara] collected in Japan; now it belongs in *Erysiphe* sect. *Microsphaera*. The main differentiating characters of this powdery mildew are evanescent mycelium, 6–8-spored asci, and appendages which are thick-walled throughout and brown from the base up to the middle of the stalk or even spreading into the upper half. *Erysiphe syringae* Schwein., a species with a similar host spectrum and also a member of *Erysiphe* sect. *Microsphaera*, has a persistent mycelium, mostly 4–5-spored asci, and appendages thin-walled towards the apex, hyaline or only slightly brownish at the base (Braun 1987).

Since the original description of *Erysiphe syringae-japonicae* by Braun (1982a), numerous additional records from East Asia have been published. This powdery mildew is common in China, Japan, Korea, and the Far East of Russia (Braun 1987, 2002, Shin 2000). Recently an epidemic spread of *E. syringae-japonicae* from Asia westward to Europe has been observed. The first European record of this species has been published by Braun (1998), based on material collected in 1998 at Halle/Saale in Germany. In fact, I also found the teleomorph of this powdery mildew at Tarnów in Poland in 1998 (KRAM F-52738, reported here), and in 2002 I collected numerous additional specimens at Kraków. Other European collections are from Switzerland and from St. Petersburg in the European part of Russia (Braun 2002), which means that *Erysiphe syringae-japonicae* has been well established in Europe at least since 1998.

To date, several species of *Syringa* L. have been recorded as natural hosts of *Erysiphe syringae-japonicae*. In East Asia, it occurs on *Syringa amurensis* Rupr., *S. dilatata* Nakai, *S. josikaea* Jacq.f., *S. oblata* Lindl. *ex* Carr., *S. reticulata* (Blume) Hara, *S. robusta* Nakai, *S. tomentella* Bureau & Franch., *S. velutina* Kom., *S. vulgaris* L., and *S. wolfii* C. K. Schneider (Braun 1987, 2002). In Europe, it was reported on *Syringa* × *chinensis* Willd. and *S. vulgaris*, but in the present study additional host species have been detected, viz. *Syringa tomentella*, new to Europe, and *S.* × *prestoniae* McKelvey as well as*S. persica* L. var. *integrifolia* L., which are new host species at all.

CONCLUSION

The climatic conditions prevailing in Europe for several years, with higher temperature and humidity, favour the massive occurrence of Erysiphales, including various introduced species, such as *Erysiphe flexuosa* (Peck) U. Braun & S. Takamatsu, *E. palczewskii* (Jacz.) U. Braun & S. Takamatsu, *E. russellii* (Clinton) U. Braun & S. Takamatsu, *E. symphoricarpi* (Howe) U. Braun & S. Takamatsu, *E. syringae* Schwein., *E. vanbruntiana* (W. R. Gerard) U. Braun & S. Takamatsu, etc. Kreisel and Scholler (1994) classified such fungi as neomycetes, i.e., fungi introduced to new areas, which are able to establish themselves in natural or cultivated habitats. *Erysiphe azaleae* and *E. syringae-japonicae* are two species recently introduced to Europe, which can be considered to be neomycetes. The former has been established on the continent since 1996 and the latter since 1998, at least as teleomorphic states. It cannot be ruled out that the powdery mildew anamorphs known in Europe for several years on hosts of the genera *Rhododendron* and *Syringa* belonged to *E. azaleae* and *E. syringae-japonicae*, respectively. It seems to be characteristic that in the first years after introduction only the anamorph is formed, which could also be the case for the two powdery mildews discussed in this paper. Analyses of ITS sequences of the rDNA of herbarium samples of anamorphs collected before the first observations of the teleomorphs and new collections of the teleomorphs of *E. azaleae* and *E. syringae-japonicae* could clarify this question.

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A NEW RECORD AND TWO NEW COMBINATIONS IN MICROBOTRYALES

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ABSTRACT

Microbotryum violaceo-verrucosum on *Silene mellifera* is reported as a new smut fungus for Africa. For two *Ustilago* species on Commelinaceae new combinations into *Bauerago*, *B. commelinae* and *B. combensis*, are proposed.

KEYWORDS: smut fungi, taxonomy, *Microbotryum*, *Bauerago*

NEW RECORD

Revision of specimens of anthericolous *Microbotryum* spp. from the Herbarium of the University of Helsinki has yielded *M. violaceo-verrucosum* as a new record for Africa. The material was examined in lactophenol. The measurements of ustilospores are given in the form: min–max (mean ± 1 standard deviation).

Microbotryum violaceo-verrucosum (Brandenb. & Schwinn) Vánky, Mycotaxon **33:** 372. 1988.

Sori in the anthers. Spore mass powdery, dark purple. Ustilospores globose, subglobose, broadly ellipsoidal or ovoid, 5–6.5 × 5–5.5 (5.7±0.4 × 5.4±0.4) µm; exospore verruculose.

Specimen examined. On *Silene mellifera* Boiss. & Reuter: MOROCCO, C. Djabel Mahmel in montibus Aurasiis, 30.VI.1920, R. Maire (as *Ustilago violacea* Pers.) (H).

E. J. Butler (type on *Aneilema nudiflorum* (L.) Wall. ex C. B. Clarke, India) is not a smut fungus but an ascomycete (*Ustilaginoidea burkillii* (Syd., P. Syd. & E. J. Butler) Thirum.).

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The plant material is very scanty and it is impossible to identify the host with certainty. Liro (1924), Maire & Werner (1937), and Zundel (1953) published this specimen under the name of *Ustilago violacea* (Pers.) Rouss.

Microbotryum violaceo-verrucosum has previously been reported from Central Europe (Germany, Poland, Austria, Switzerland, and Hungary), Romania, and Mediterranean and sub-Mediterranean regions of Europe (Portugal, Spain, France, Italy, Serbia, Macedonia, Bulgaria, Greece, and Turkey) (Durrieu 1972; Brandenburger & Schwinn 1974; Denchev 1994, 1995a, b, 1997; Denchev *et al.* 1997). On *Silene mellifera* it was known only from Portugal (Denchev 1995a).

TWO NEW COMBINATIONS INTO *BAUERAGO*

From the time when the species of *Ustilago* proper have been restricted only to host plants of Poaceae (Vánky 1998, 1999, 2001, etc.) and new genera for the former "*Ustilago*" species on Cyperaceae and Juncaceae, viz. *Bauerago* (Vánky 1999), and on Liliaceae, viz. *Vankya* (Ershad 2000) have been proposed, it was obvious that "*Ustilago*" species on Commelinaceae should be transferred into another genus. Piepenbring (2002) described a new species of *Bauerago* on *Commelina* sp. from Bolivia, *Bauerago boliviana*, and she presumed a generic position of other known "*Ustilago*" species on Commelinaceae in *Bauerago*, too. Because among these species is a smut fungus, common for East Asia, *U. commelinae* (Kom.) Zundel, distributed also in USA, this transfer seems to be exigent. Consequently, the following new combinations into *Bauerago* are proposed:

***Bauerago commelinae* (Kom.) Denchev**, *comb. nov.*
Basionym: *Tilletia commelinae* Kom. in Jaczewski, Komarow & Tranzschel, Fungi Rossiae Exsiccati, no. 210, 1899. — *Ustilago commelinae* (Kom.) Zundel, Ustil. World, p. 151, 1953. — Type on *Commelina communis* L., China, Heilongjiang Prov., near the town Mao-ell-shan, Jalu Valley, 3-14.IX.1897, V. L. Komarov; isotypes in Jacz., Kom. & Tranz., Fgi. Ross. exs., no. 210.

For its description and illustrations see Vánky (1994).

On Commelinaceae: *Commelina communis* L., East Asia (China, Japan, Russia), North America (USA).

***Bauerago combensis* (Vánky) Denchev**, *comb. nov.*
Basionym: *Ustilago combensis* Vánky, Mycoscience **35:** 358, 1994. — Type on *Commelina benghalensis* L., Pakistan, Murree, VIII.1952, S. Ahmad, HUV 8966; isotype Herb. S. Ahmad (Lahore).

For its description and illustrations see Vánky (1994).

On Commelinaceae: *Commelina benghalensis* L., South Asia (Pakistan).

The *Ustilago* species on Commelinaceae are revised by Vánky (1994). The morphological and ultrastructural characters of *Bauerago* are presented in Vánky (1999, 2002). Thirumalachar (1950: 168) stated that *Ustilago burkillii* Syd., P. Syd. &

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NOTES ON WYNNEA (PEZIZALES) FROM ASIA*

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Abstract: Collections of *Wynnea* from China on deposit in HMAS and a few from Japan were examined. Three species, *Wynnea gigantea*, *W. macrospora* and *W. macrotis*, are recognized. The circumscription of *W. macrospora* is discussed.

Key words: Correction, synonyms, taxonomy, *Wynnea macrospora*, SEM

Wynnea Berk. & M.A. Curtis is a well-characterized genus in the Pezizales possessing large and ear-shaped apothecia several arising from a common stalk, vinaceous, purplish red to purplish brown hymenium surface in fresh condition, suboperculate asci, and subfusoid to subellipsoid ascospores with non-cyanophilous, longitudinal ribs. Species of the genus have been reported from different regions of the world (Teng, 1934; Imai, 1938; Rifai, 1968; Pfister, 1979; Otani, 1980; Liu et al., 1987). The first record of the genus from China was by Patouillard (1895) when *Midotis gigantea* (Berk. & M.A. Curtis) Sacc. var. *nana* Pat. [= *Wynnea macrotis* (Berk.) Berk.] was established based on material from Kangding (Tchen-Kéon-Tin), Sichuan Province. Later *W. gigantea* Berk. & M.A. Curtis was reported from Yunnan by Teng (1934) and from Anhui, Jiangxi, Shanxi, Shaanxi, Sichuan, and Zhejiang (Teng, 1963). In the past 20 years, names like *W. americana* Thaxt., *W. macrospora* B. Liu & J.Z. Cao, and *W. sinensis* B. Liu & J.Z. Cao appeared (Liu et al., 1987; Zhuang, 1995). Two species, *W. americana* and *W. gigantea*, were also reported from Japan (Otani, 1980). This study is based mainly on re-examinations of the *Wynnea* collections from China on deposit in HMAS (Mycological Herbarium, Institute of Microbiology, Chinese Academy of Sciences) as well as a few specimens from Japan.

TAXONOMY

1. **Wynnea gigantea** Berk. & M.A. Curtis, J. Linn. Soc. Bot. 9: 424, 1867. (Fig. 1-2)
= *Wynnea sinensis* B. Liu & J.Z. Cao, Mycotaxon 30: 467, 1987.

Specimens examined: CHINA. Guizhou: Panxian, on the ground in woods, 1984 IX 12, M.H. Liu, HMAS 71897 (ex MHSU 571), isotype of *Wynnea sinensis*; on the ground, 1984 IX 12, M.H. Liu, HMAS 71895. Jiangxi: Lushan, on the ground, 1958

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X 5, Anon. collector, HMAS 24113. Hubei: Shennongjia, on the ground, 1984 VIII 9, S.X. Sun 480, HMAS 70286. Xizang: Jilong, 1990 VIII 31, J.Y. Zhuang 3678, HMAS 57853. Yunnan: Anning, on the ground, 1977 VI 15, Y.C. Zong, Q.M. Ma & L.W. Xu 420, HMAS 42197; Kunming, on the ground, C.C. Cheo 5207, HMAS 1207; on the ground in woods, 1965 I 5, Q.T. Chen 156, HMAS 35869; Menghua, on the ground, 1933 IX 19, Y. Jiang 14, HMAS 7239; Xichou, Xiaoqiaogou, on the ground, 1959 V 19, Q.Z. Wang 228, HMAS 25221. JAPAN. Tochigi Pref.: Nasu-cho, Nasu Highlands, in broadleaved forest, 1995 VII 22, Anon. collector, 95-C-310. Aomori Pref.: Aomori City, Tsukimino, on the ground in a *Quercus* forest, 1998 VIII 8, Anon. collector, 98-C-893.

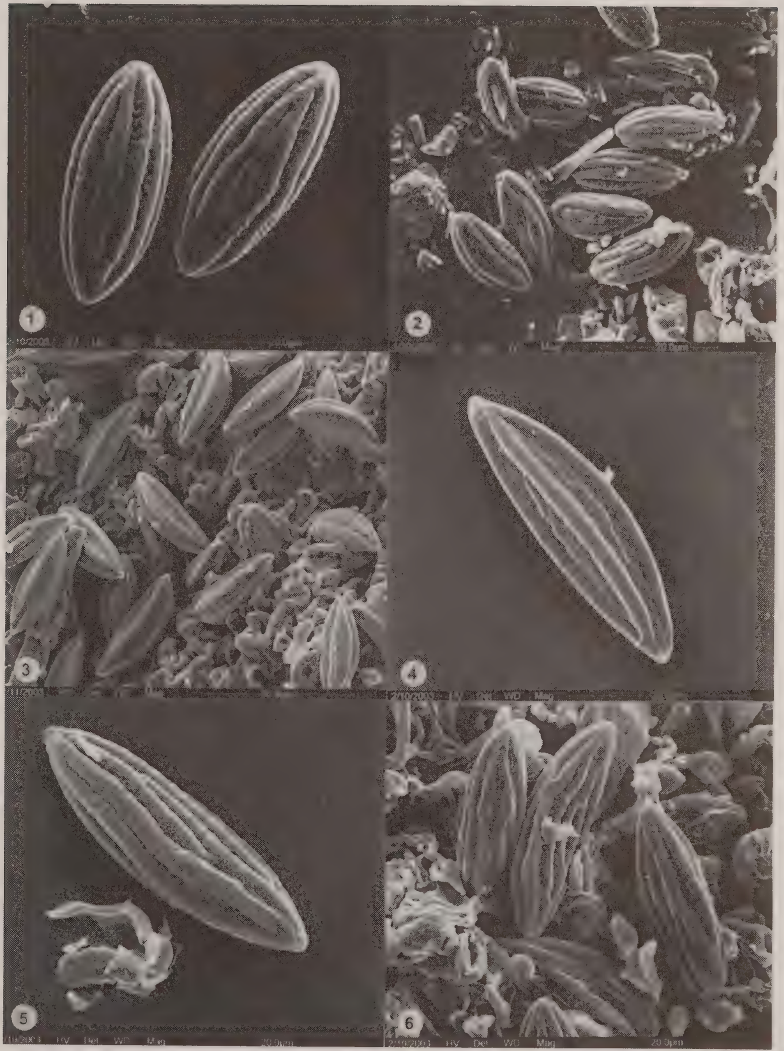
Known distribution: China, Japan, Mexico, Brazil, Peru.

Notes: The combination of smooth receptacle surface, outer excipular cells arranged in a palisade layer, and ascospores shorter than 35 μm and not obviously papillate at both ends distinguishes this fungus from other members in the genus. Otani (1980) reported that the Japanese collections of the fungus produced sclerotia under the ground. Similarly, a well-developed, irregularly-shaped, dark brown sclerotium was found in a collection from Xichou, Yunnan (HMAS 25221). *Wynnea sinensis* possesses somewhat smaller ascospores and is treated here as a synonym of *W. gigantea*.

2. **Wynnea macrospora** B. Liu & J.Z. Cao, Mycotaxon 30:465, 1987. emend. nov. (Figs. 3-4, 7)

Sclerotia formed in some collections, irregular in shape and with many tubercles, surface nearly black when dry. Apothecia spathulate or ear-shaped, erect, 35–45 × 70–120 μm or larger; hymenium surface vinaceous, purplish brown to dark brown when fresh, very dark brown to nearly black upon drying; receptacle surface nearly concolorous with hymenium surface when dry, minutely to obviously pustulate, especially at the lower portion of an apothecium. Ectal excipulum of textura angularis to textura globulosa, 50–100 μm thick excluding the pustules, cells 15–35 μm wide; pustules conical, of 1–3 cell layers, ca 25–68 μm high. Medullary excipulum of textura intricata, 300–1100 μm thick. Subhymenium 25–60 μm thick. Hymenium 280–400 μm thick. Asci subcylindrical, narrower towards the base, 8-spored, J– in Melzer's reagent, 370–390 × 18–22 μm wide. Ascospores fusoid, sometimes flat on one side, slightly pointed with a papilla at each end, mostly with 2–3 coarse ridges viewed on one surface, multiguttulate, hyaline to subhyaline, uniseriate, (35–)38–46(–48.3) × (11.5–)12.5–16.5(–18) μm. Paraphyses filiform, septate, anastomosing, 3–6.5 μm wide.

Specimens examined: CHINA. Guizhou: Suiyang, on the ground, 1987 VIII 12, M.H. Liu 1020, HMAS 71889; Suiyang, on the ground, 1984 VIII 2, M.H. Liu 482, HMAS 71898 (holotype, formerly deposited as MHSU 570), HMAS 71885 (isotype). ?Jiangxi: on the ground, 1935 IX 5, E. Licent 5159, HMAS 29360. Jilin: Jiaohe, on the ground, 1991 VIII 29, J.B. Chen, F.Y. Bai & W.Y. Zhuang 783, HMAS 60669. Liaoning: Kuandian, on the ground, 1987 VIII, Y.S. Yuan, HMAS 53612. Shaanxi: Taibaishan, on the ground, 1958 IX 14, S.J. Zhang 683, HMAS 26049.



Figs. 1-6. Ascospore surface morphology (SEM): 1-2. *Wynnea gigantea*, 1 from HMAS 24113, 2 from HMAS 70286; 3-4. *W. macrospora*, 3 from HMAS 62474, 4 from HMAS 60669; 5-6. *W. americana*, from FH – Reliquiae Farlowianae no. 647.

Sichuan: Baoxing, on the ground, 1956 VIII 30, Anon. collector in foray organized by the Ministry of Forestry 4-0052, HMAS 19937; Gongga Mountains, on the ground, 1997 VIII 21, Z. Wang 2130, HMAS 62474; Jiuzhaigou, on the ground, 1986 X 8, W.Y. Li 121, HMAS 71952, HKAS; Wolong, on the ground, 1983 VIII 7, H.A. Wen & J.J. Su 495, HMAS 50721. JAPAN. Hiroshima Pref.: Hiba-gun, Kenmin-no-mori, 1996 IX 25, Anon. collector, TRL-1451.

Known distribution: China, Japan.

Notes: When the holotype of *Wynnea macrospora* was examined, minute to small-sized pustules were found on the receptacle surface, which were overlooked by the original authors (Liu et al., 1987) as mistakenly shown in their description and illustration. Thus, *Wynnea macrospora* becomes a very similar species to *W. americana*. They can be separated solely by spore size, which makes the separation of the two fungi from two different geographic regions ambiguous at species level. When the lectotype of *W. americana* was carefully examined and compared with the Chinese fungus, I found that the size of its mature ascospores is slightly lager than that reported by Pfister (1979) [34.5–42(–45.5) × 12.5–15(–17.5) μm vs. 35–38(–40) × 12–14(–18) μm]. Thus the two characters separating *W. macrospora* from *W. americana* became even less distinctive. Moreover, different authors have provided a diverse range of spore size for *W. americana*. i.e., 32–40 × 15–16 μm by Seaver (1928), 35–38(–40) × 12–14(–18) μm by Pfister (1979), 32–47 × 15–19 μm by Otani (1980), and 32–41 × 11–14.5 μm by Kaushal (1983). Is it possible that both represent a single species? Since the striations on the spore surface are cyanophobic, spore surface morphology is not clearly observable under the light microscope, I pursued SEM studies of spore surface morphology of *W. americana* and *W. macrospora*. My observations revealed that number of spore striations of *W. americana* is greater than in *W. macrospora*, the papilla at spore ends is less apiculate or less prominent in *W. americana*, and some of the longitudinal ridges on spores of *W. americana* produce a short branch in the middle of a main ridge, whereas, those in *W. macrospora* run

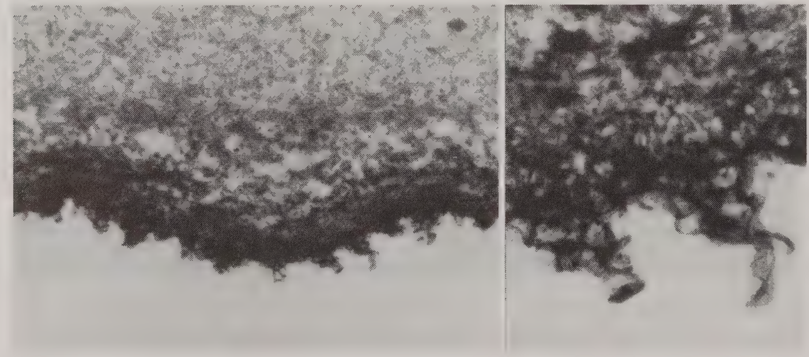


Fig. 7. Ectal excipular structure of *Wynnea macrospora*, left ×60, right ×240; from HMAS 62474.

directly from one pole to the other without branching. I conclude that they should be treated as separate species.

Among the Chinese materials studied, the height of pustules on the receptacle surface varied in collections from low in the holotype of *W. macrospora* (HMAS 71898) to very prominent in the collection from Sichuan (HMAS 62474), with that from Jiaohe, Jilin just in between. The ascospore size of the Chinese material is very close to that of the Japanese collections reported as *W. americana* (Otani, 1980). Materials of *Wynnea* from Japan were therefore borrowed and compared with the Chinese ones. Even though the Japanese collection (TRL-1451) has prominent pustules on receptacle surface, the ascospore characteristics are exactly the same as *W. macrospora* from China. It is quite possible that the previous Japanese record of *W. americana* is based on a mis-identification of *W. macrospora*.

3. Wynnea macrotis (Berk.) Berk., J. Bot. (Hooker) 3: 203, 1867.
= *Midotis gigantea* (Berk. & M.A. Curtis) Sacc. var. *nana* Pat., Bull. Soc. Mycol. France 11: 198, 1895.

Known distribution: China, India.

Notes: Material of *Midotis gigantea* var. *nana* from Kangding, Sichuan was not available in HMAS and was not examined by the author. According to Pfister (1979), collections of *Wynnea macrotis* were poorly preserved and the species remained enigmatic. The morphology of *W. macrotis* seems similar to that of *W. gigantea*. The former is apparently distinguishable from the latter in the presence of curved to coiled, short hyphal protrusions arising from the outermost cells of the receptacle and the smaller ascospores.

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A NEW SPECIES AND A NEW RECORD OF LACHNUM FROM TAIWAN

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ABSTRACT: A new species and a new record of *Lachnum* are described and illustrated from Taiwan. The new species, *Lachnum meifengense,* is characterized by its foliicolous habitat, white apothecia, fusiform ascospores, and lanceolate paraphyses. A newly recorded species, *Lachnum patenum,* is recognized by its white apothecia and long fusiform ascospores.

Key Words: discomycetes, Helotiales, Hyaloscyphaceae

Lachnum meifengense Y. Z. Wang, sp. nov. (Figs. 1, 3)

Apothecia minuta, gregaria, 0.3-0.8 mm diam., stipitata. Discus albus, sicco pallidescens flavus. Receptaculum cupulatum, subalbum, coopertum ad album pilis. Stipes centralis, cylindricus, 0.2-0.6 mm altus, sparsum coopertum ad album pilis. Excipulum ectale inaequalium textum primaticum, 10-20 x 5-10 μm. Excipulum medullosae textum intricatum, 30-50 μm crassum, hyphae 2-4 μm latum. Hymenium stratum 60-75 μm. Pili 50-70 x 3-4 μm, hyalini, cylindrici, obtusi, muris tenuibus, sparsi septati, omnino granulati, subnulli crystallini an exsudati resinosi. Asci 8-spori, cylindrici-clavati, 38-50 x 5-6 μm,, apice conico, poro in Melzero caerulescente. Ascosporae (20-)24-27(-31) x 1-1.5 μm, hyalinae, anguste fusiformie, directae ad subarcuatae, non-septatae. Paraphyses lanceolati, hyalini, apici acutis, 2-3 μm ad maxine lati, sparsi septati, directi, impaniculati, ascos excedentes leviter 5-10 μm.

Apothecia minute, gregarious, on both surfaces of the leaf blade, nearly globose when young, opening to plane at maturity, 0.3-0.8 mm in diam., stipitate. Disc white, turning pale yellow when dry, with a regular, circular margin. Receptacle pale white, clothed with white hairs. Stipe central, cylindrical, 0.2-0.6 mm high, sparsely clothed with white hairs. Ectal-excipulum layer 20-30 μm thick, of irregular *textura prismatica*, formed by hyaline, thin-walled cells, 10-20 x 5-10 μm. Medulary excipulum 30-50 μm thick, of *textura intricata*, composed of thin-walled, hyaline, loosely interwoven hyphae, 2-4 μm in diam. Hymenium layer 60-75 μm. Hairs 50-70 x 3-4 μm, hyaline, cylindrical, obtuse, thin-walled, sparsely septate, granulate throughout, lacking crystals or resinous exudates. Asci 8-spored, cylindrical-clavate, 38-50 x 5-6 μm, conical at apex, the pore outlined blue in Melzer's reagent, basal septum 2-3 μm across, without a crozier. Ascospores (20-)24-27(-31) x 1-1.5 μm, hyaline, narrowly fusiform, straight or slightly curved, tapered at each end, non-septate, filling the ascus and irregularly arranged in 2-3 overlapping series. Paraphyses lanceolate, hyaline, acute at apex, 2-3 μm at the widest point, sparsely septate, straight, unbranched, slightly overtopping the asci by 5-10 μm.

Holotype: Taiwan, Nantou: Meifeng, elev. 2150 m; on dead leaves of *Quercus* spp., June 29, 1999, coll. Y. Z. Wang, WAN 689 (TNM F9851).

Etymology: Latinized from Meifeng; locality of the type collection.

Habitat: Saprophytic, on dead leaves of Fagaceae.

Additional specimens examined: Taiwan, Miaoli: Kuanwu, elev. 1900 m; on dead leaves, June 18, 1996, coll. W. N. Chou, WAN 297 (TNM 4714); Kuanwu, elev. 2000 m, on dead leaves, June 9, 1999, coll. W. N. Chou, WAN 696 (TNM F9856). Nantou: Meifeng, elev. 2250 m, on rotten leaves, July 3, 1996, Y. Z. Wang, WAN 307 (TNM F5132); Meifeng, elev. 2150 m, on dead *Quercus* leaves, Aug. 7, 1997, Y. Z. Wang, WAN 460 (TNM F7390).

This species shares some common characteristics with other foliicolous species; *Lachnum ciliare* (Schrader : Fr.) Rehm, *L. confertum* Spooner, *L. nipponicum* J. Haines and Kaneko, and *L. radiatum* Tanaka and Hosoya, by having stipitate apothecia with pale hymenium and white hairs, and fusiform ascospores. However, *L. ciliare* and *L. radiatum* have hairs capped by crystals and short ascospores (Dennis 1949, Tanaka and Hosoya 2001); and *L. nipponicum* has yellow apothecia and septate ascospores (Haines and Kaneko, 1984). The type of *L. confertum* is also examined. *Lachnum meifengse* is differentiated from it by the stipitate apothecia, narrower and longer ascospores, and lanceolate paraphyses (Spooner 1987).

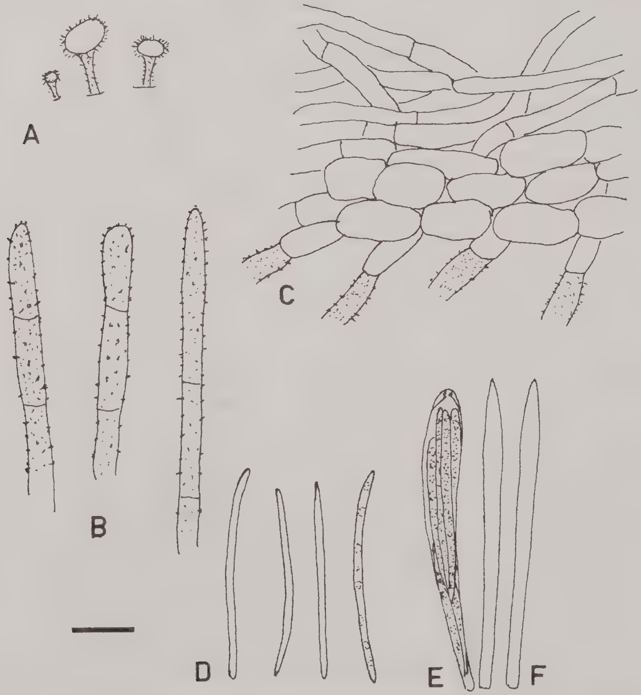

Fig. 1. *Lachnum meifengense,* holotype. A. Apothecia. B. Hairs. C. Ectal-excipulum. D. Ascospores. E. An ascus. F. Paraphyses. Bar = 1.2 mm for A; 10 μm for B-F.

Lachnum patenum (Lév.) J. Haines & Dumont

Apothecia scattered, globose when young, opening to goblet-shaped at maturity, 0.2-0.5 mm diam., stipitate. Disc white, turning to pale yellow when dry. Receptacle white, clothed with white hairs often agglutinated at the tips. Ectal-excipulum of irregular *textura prismatica*, thin-walled cells 5-10 x 4-5 μm. Medullary excipulum of textura intricate. Hairs white, 50-60 x 4-5 μm, hyaline, cylindrical, obtuse, granulate throughout, lacking crystals. Asci 8-spored, clavate-cylindrical, 85-90 x 7-8 μm, conical at the apex, the pore outlined blue in Melzer's reagent. Ascospores narrowly fusiform, slender, 60-65 x 1.5-2 μm, hyaline, 0-6-septate, straight or curved. Paraphyses subcylindrical, 2-3 μm at the widest point, sparsely septate.

Specimen examined: Taiwan, Taichung: Anmashan, elev. 2100 m, on unknown dicotyledon herbaceous stem, July 15, 2002, coll. W.N. Chou, WAN 905 (TNM F0014667).

This species is characterized by the white apothecia with long fusiform ascospores. According to Haines and Dumont's (1984) description, it grows on woody Compositae stems in cloud forests of Central and South America and has large white masses of matter on the hairs. This Taiwan specimen was also collected from a cloud forest at high elevations; however those white masses were not observed on the hairs. This species is herein first reported from Asia.

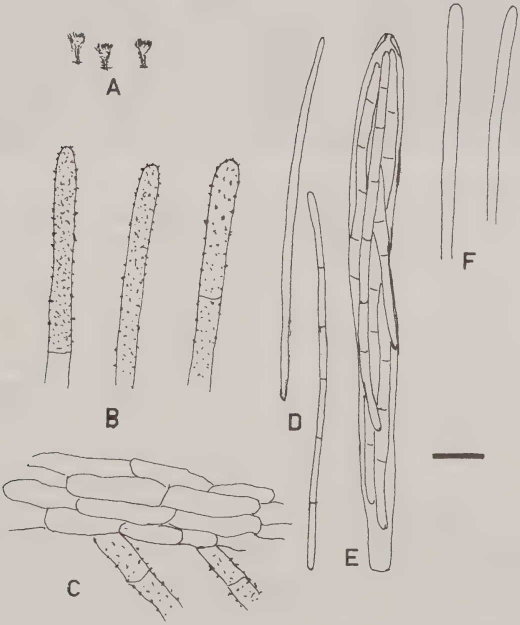

Fig. 2. *Lachnum patenum.* A. Apothecia. B. Hairs. C. Ectal-excipulum. D. Ascospores. E. An ascus. F. Tips of the paraphyses. Bar = 1.2 mm for A; 10 μm for B-F.

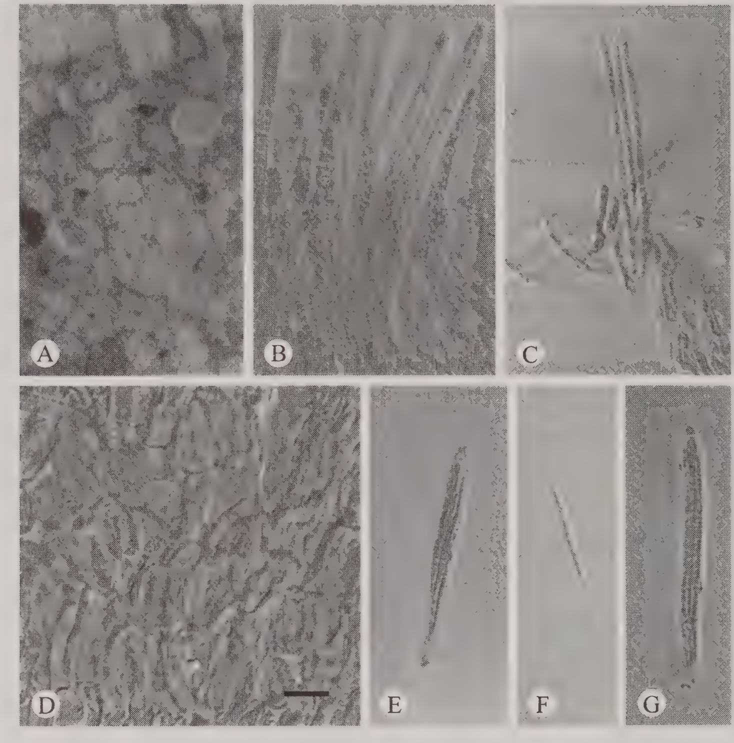

Fig. 3. *Lachnum meifengense,* holotype. A. Two apothecia. B. Hairs. C. Paraphyses. D. Ectal-excipulum. E. An ascus. F. An ascospore. G. *Lachnum patenum*; An ascus. Bar = 0.6 mm for A; 10 μm for B-F; and 20 μm for G.

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PHYLOGENETIC ANALYSIS PLACES THE PHIALOPHORA-LIKE ANAMORPH GENUS CADOPHORA IN THE HELOTIALES

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ABSTRACT

Using ITS and 28S (LSU) rDNA sequences, members of the genus *Cadophora* are shown to be anamorphs of the Helotiales (discomycetes) and distinct from the morphologically similar anamorph genus *Phialophora*. The rDNA sequences of *Cadophora* spp. were similar to those of the teleomorph genera *Mollisia*, *Pyrenopeziza*, and *Tapesia* (which have anamorphs in *Ramulispora*) and to the anamorph genera *Phialocephala* and *Rhynchosporium*. The type species of *Cadophora* is *C. fastigiata*, and *C. malorum* is another common species in the genus. Also included are *C. finlandia* comb. nov., the soybean pathogen *C. gregata* comb. nov., *C. lagerbergii*, *C. luteo-olivacea* comb. nov., and *C. melinii*. *Phialophora atra* and *C. heteroderae* are synonymized with *C. malorum*. *Phialophora goidanichii* is synonymized with *C. luteo-olivacea*.

KEY WORDS: *Phialocephala, Ramulispora, Rhynchosporium, Pyrenopeziza, Tapesia*

INTRODUCTION

The anamorph genus *Phialophora* Medlar has been used for a wide range of species with simple, little-differentiated conidiophores, flask-shaped to straight phialides, and hyaline to pigmented conidia. Many of these species have not been connected to teleomorphs, but the genus is clearly polyphyletic (Gams 2000). *Phialophora* is typified by *P. verrucosa* Medlar and connected to the genus *Capronia* Sacc. (Chaetothyriales, Herpotrichiellaceae) (Haase *et al.*, 1999, de Hoog *et al.*, 2000), but phialophora-like anamorphs are known in at least three orders of ascomycetes.

As reviewed by Gams (2000), teleomorphs with connections to phialophora-like anamorphs are common in the Helotiales. Species of *Ascocoryne* J.W. Groves & D.E. Wilson have anamorphs in *Coryne* Nees, which is similar to *Phialophora*, as are the *Myrioconium* Syd. anamorphs of some Sclerotiniaceae. The anamorph of *Hyphodiscus hymeniophilus* (P. Karsten) Baral (≡*Cistella hymeniophila* (P. Karst.) Korf) is *P. rhodogena* (Mangenot) W. Gams (≡ *Catenulifera rhodogena* (F. Mangenot) Hosoya) (Hosoya 2002). Using 18S and 28S rDNA sequences, Paulin and Harrington (2000) showed that the soybean pathogen *P. gregata* (Allington & Chamberlain) W. Gams has affinities with the Helotiales. The Dermateaceae, in particular, commonly have phialophora-like anamorphs, such as the *Cystodendron* Bubák anamorphs of species of *Tapesia* (Pers.) Fuckel (Aebi 1972). *Phialophora tracheiphila* (Sacc. & D. Sacc.) Korf is associated with the teleomorph *Pseudopezicula tracheilphila* (Müll.-Thurg.) Korf & Zhuan (Korf *et al.*, 1986).

Gams (2000) proposed that the phialophora-like anamorphs of the Dermateaceae, such as *Mollisia* (Fr.) P. Karst. and *Pyrenopeziza* Fuckel (Le Gal & Mangenot 1960, 1961), might be accommodated in *Cadophora* Lagerberg & Melin, species of which have pale to hyaline collarettes on top of their phialides. *Cadophora* was synonomized with *Phialophora* by Conant (1937), but the genus name *Cadophora* has often been used for some common bluestain fungi such as *C. fastigiata* Lagerberg & Melin, the type species of *Cadophora*. Greenleaf and Korf (1980) isolated a fungus similar to *C. fastigiata* from *Mollisia dextrinophila* Korf.

We used morphology and rDNA sequences to determine which phialophora-like species might have affinities to the Helotiales and to confirm the connection of *Cadophora* to the Dermateaceae. New combinations in *Cadophora* are proposed, and the taxonomy of the recognized species is reviewed.

MATERIALS AND METHODS

Many of the isolates used for DNA sequencing were purchased from the Centraalbureau voor Schimmelcultures (CBS). Phialophora-like species such as *C. malorum*, morphologically similar species, and their suspected synonyms were emphasized, particularly those thought to have affinities to the Helotiales. Cultures of other *Phialophora* species that would be representative of other orders of ascomycetes were also purchased from CBS and sequenced.

Two regions of nuclear rDNA were used: a portion (5' end) of the large subunit (LSU or 28S) and the internal transcribed spacer regions (ITS1 and ITS2), along with the highly conserved 5.8S gene. The procedures for DNA extraction, the PCR and sequencing primers, cycling conditions for PCR, and automatic sequencing were as described by Paulin *et al.* (2002). Complementary sequences were obtained and compared to assure fidelity.

BLAST searches were conducted with sequences of the phialophora-like species to find similar sequences. Corresponding sequences of representative species were included in the datasets for phylogenetic analyses. For analysis of the LSU dataset, sequences of representatives of the Helotiales, Sordariales and Chaetothyriales were included, and we used the sequences of *Saccharomyces* and *Bulleromyces* (Basidiomycota) as the outgroup taxa.

For each dataset, sequences were aligned manually and analyzed using PAUP 4.0b10a (Swofford 2002). A total of 566 unordered characters, including gaps, were utilized in the LSU dataset of 53 taxa, but 11 characters were eliminated because of ambiguous alignment. Of the 555 analyzed characters, 241 were constant and 73 were parsimony-uninformative. The tree was rooted to *Bulleromyces* at an internal node with basal polytomy. For the ITS dataset, the manual alignment resulted in 596 characters, including gaps. Of these, 119 were eliminated because of ambiguous alignment, 268 characters were constant, and 81 characters were parsimony uninformative. The ITS tree was rooted to *Pyrenopeziza revincta*.

Heuristic searches used stepwise (simple) addition and tree-bisection-reconnection. For both datasets, gaps were considered a "fifth base," all characters had equal weight, starting trees were obtained via stepwise addition, and tree-bisection-recombination was used. Bootstrap analyses utilized 1000 replications of heuristic searches (Felsenstein 1985).

Table 1. Isolate numbers of species and GenBank accession numbers of the ITS and LSU rDNA sequences generated in this study.

Species	Isolate Numbers[a]	ITS rDNA	LSU rDNA
Cadophora fastigiata	A168, CBS 307.49	AY249073	AY249084
C. finlandia	P60, CBS 444.86, *ex-type* of *Phialophora finlandia*	AY249074	
C. gregata	P19	AY249070	
	P21	AY249071	
C. luteo-olivacea	A171, CBS 352.87	AY249069	
	A174, CBS 357.51, *ex-type* of *Phialophora goidanichii*	AY249068	AY249082
	A175, CBS 141.41, *ex-type*	AY249066	AY249081
	A208	AY249067	AY249087
C. malorum	A163, CBS 266.31, *ex-type* of *Sporotrichum carpogenum*	AY249057	AY249080
	A165, CBS 257.89	AY249058	
	A166, CBS 377.77	AY249064	
	A167, CBS 165.42, *ex-type* of *Phialophora atra*	AY249059	AY249086
	A169, CBS 259.32, *ex-type* of *Cadophora heteroderae*	AY249060	AY249083
	A170, CBS 260.32	AY249061	
	A172, CBS 100591	AY249063	
	A173, CBS 100584	AY249062	
C. melinii	A164, CBS 268.33, *ex-type*	AY249072	AY249085
Graphium rubrum	C1223, CBS 210.34, *ex-type*	AF198245	AY266313
G. silanum	C1221, CBS 206.37	AY249065	
Leptographium abietinum	C1883		AY249091
Phaeoacremonium aleophilum	A207		AY249088
Phialocephala dimorphospora	P59, CBS 300.62	AY249075	
Phialocephala fortinii	P58, CBS 443.86, *ex-type*	AY249076	
Phialophora brunnescens	A178, CBS 295.39, *ex-type*	AY249079	
Phialophora calyciformis	A177, CBS 302.62, *ex-type*	AY249077	AY249090
Phialophora richardsiae	A176, CBS 270.33, *ex-type*	AY249078	AY249089

[a] CBS = Centraalbureau voor Schimmelcultures, Netherlands; A, C and P = Culture collection of T. C. Harrington, Iowa State University.

RESULTS

LSU Sequence Analysis

Partial sequences of the LSU gene were obtained for 10 isolates of what were thought to be species of *Cadophora*. The BLAST searches for similar LSU sequences indicated that nine of the ten *Cadophora* species grouped together and suggested that they were most closely related to taxa in the Helotiales.

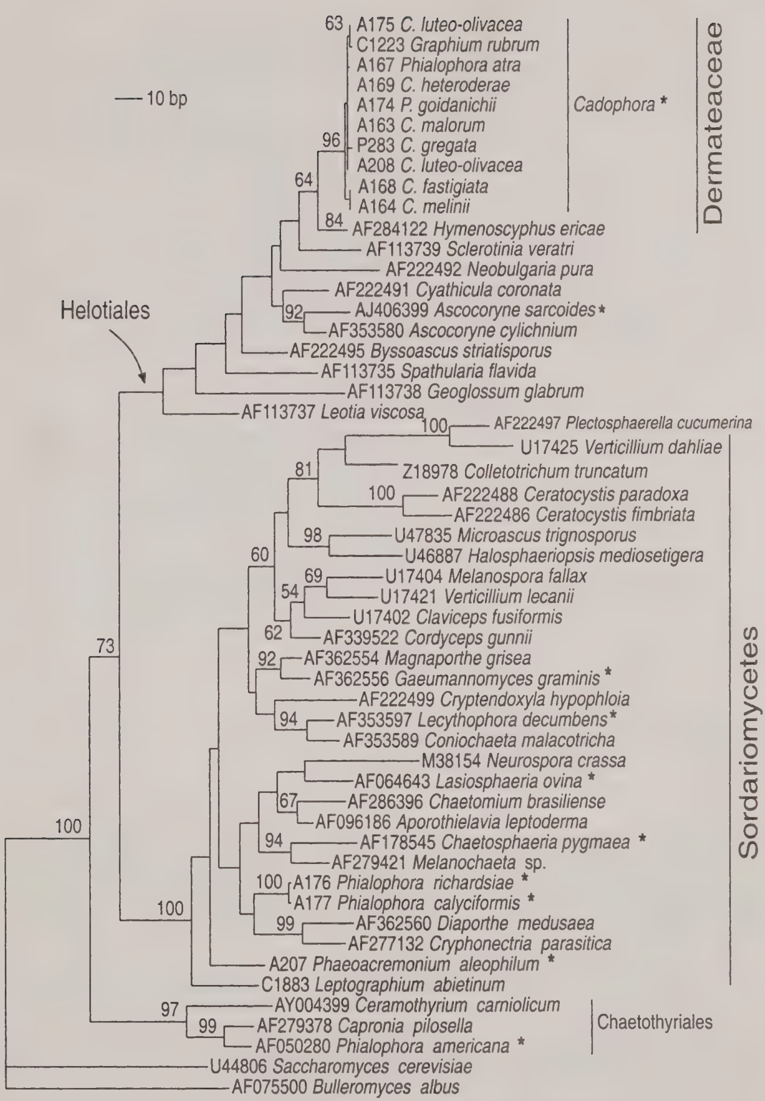
The LSU dataset included 53 taxa. Eight most parsimonious trees of 1434 steps were found, and a representative of those eight trees is shown in Figure 1. The consistency (CI), homoplasy (HI), retention (RI) and rescaled consistency (RC) indices were 0.3926, 0.6074, 0.6826 and 0.2680, respectively. The *Cadophora* species were grouped in a well-supported clade (96% bootstrap support), and this clade was sister to *Hymenoscyphus ericae* (D.J. Read) Korf & Kernan (64% bootstrap support). The *Cadophora/Hymenoscyphus* clade was in each of the eight most-parsimonious trees, as was the Helotiales branch, though there was no bootstrap support for the latter.

In contrast, the Sordariomycetes and Chaetothyriales clades were strongly-supported, and each contained phialophora-like or true *Phialophora* species, respectively (Fig. 1). *Phialophora richardsiae* (Nannf.) Conant and *P. calyciformis* G. Sm. were similar to each other and more closely matched members of the Sordariomycetes than the Helotiales. The LSU sequences of these *Phialophora* species were most similar to *Diaporthe medusaea* Nitschke and *Cryphonectria parasitica* (Murrill) M. E. Barr, but there was no bootstrap support for the branch connecting the *Phialophora* species to these members of the Diaporthales (Fig. 1). *Phialophora americana* (Nannf.) S. Hughes had a LSU sequence very near that of *Capronia* in the Chaetothyriales. *Phaeoacremonium aleophilum* W. Gams *et al.* was placed in the Sordariomycetes clade.

ITS Sequence Analysis

There was one most parsimonious tree of 454 steps in the analysis of the ITS dataset (Fig. 2). The CI, HI, RI and RC were 0.6542, 0.3458, 0.7929 and 0.5187, respectively. Most of the *Cadophora* isolates had ITS sequences identical to *C. malorum* or *C. luteo-olivacea*. These species and *C. gregata*, *C. melinii* and *C. fastigiata* were in a well-supported clade with species of *Ramulispora* Miura (anamorphs of *Tapesia* (Pers.) Fuckel species), *Rhynchosporium* Heinsen ex A.B Frank, and *Rhexocercosporidium* U. Braun. The teleomorph *Pyrenopeziza brassicae* B. Sutton & Rawl. was also found in this clade of otherwise anamorphic species. Sister to this clade was *C. finlandia* and the teleomorphic species *Hymenoscyphus ericae.*

The ITS sequences of a number of other Dermateaceae and phialophora-like anamorphs were similar to those of the above *Cadophora* clade, but there was little or no bootstrap support for grouping them with the main group of *Cadophora* species. However, *C. lagerbergii* grouped with the anamorphic species *Phialocephala dimorphospora* Kendr. and *P. fortinii* Wang & Wilcox. *Tapesia cinerella* Rehm and *Phialocephala scopiformis* Kowalski & Kehr had similar ITS sequences, as did the anamorphic species *Dactylella lobata* Dudd. and the teleomorphic species *Mollisia cinerea* (Batsch) P. Karst. The ITS sequence of *Pyrenopeziza revincta* (P. Karst.) Gremmen was the most distinct from the other Dermateaceae and their anamorphic relatives.



10 bp
63 A175 C. luteo-olivacea
C1223 Graphium rubrum
A167 Phialophora atra
A169 C. heteroderae
A174 P. goidanichii
A163 C. malorum
96 P283 C. gregata
A208 C. luteo-olivacea
64 A168 C. fastigiata
A164 C. melinii
84 AF284122 Hymenoscyphus ericae
AF113739 Sclerotinia veratri
AF222492 Neobulgaria pura
AF222491 Cyathicula coronata
92 AJ406399 Ascocoryne sarcoides *
AF353580 Ascocoryne cylichnium
AF222495 Byssoascus striatisporus
AF113735 Spathularia flavida
AF113738 Geoglossum glabrum
AF113737 Leotia viscosa
Cadophora *
Dermateaceae
Helotiales
100 AF222497 Plectosphaerella cucumerina
U17425 Verticillium dahliae
81 Z18978 Colletotrichum truncatum
100 AF222488 Ceratocystis paradoxa
AF222486 Ceratocystis fimbriata
98 U47835 Microascus trignosporus
60 U46887 Halosphaeriopsis mediosetigera
69 U17404 Melanospora fallax
54 U17421 Verticillium lecanii
U17402 Claviceps fusiformis
62 AF339522 Cordyceps gunnii
73
92 AF362554 Magnaporthe grisea
AF362556 Gaeumannomyces graminis *
AF222499 Cryptendoxyla hypophloia
94 AF353597 Lecythophora decumbens*
AF353589 Coniochaeta malacotricha
M38154 Neurospora crassa
AF064643 Lasiosphaeria ovina *
67 AF286396 Chaetomium brasiliense
AF096186 Aporothielavia leptoderma
100
94 AF178545 Chaetosphaeria pygmaea *
AF279421 Melanochaeta sp.
100 A176 Phialophora richardsiae *
A177 Phialophora calyciformis *
100
99 AF362560 Diaporthe medusaea
AF277132 Cryphonectria parasitica
A207 Phaeoacremonium aleophilum *
C1883 Leptographium abietinum
Sordariomycetes
97 AY004399 Ceramothyrium carniolicum
99 AF279378 Capronia pilosella
AF050280 Phialophora americana *
Chaetothyriales
U44806 Saccharomyces cerevisiae
AF075500 Bulleromyces albus

Fig. 1. One of eight most parsimonious trees based on sequences of part of the large subunit of the rDNA of phialophora-like species and other ascomycetes. Bootstrap values greater than 50% are indicated above the branches. An asterisk after the taxon indicates that there is a phialophora-like anamorph. The tree is rooted to the basidiomycete *Bulleromyces albus*. Isolate numbers (Table 1) or accession numbers for DNA sequences are given for each taxon.

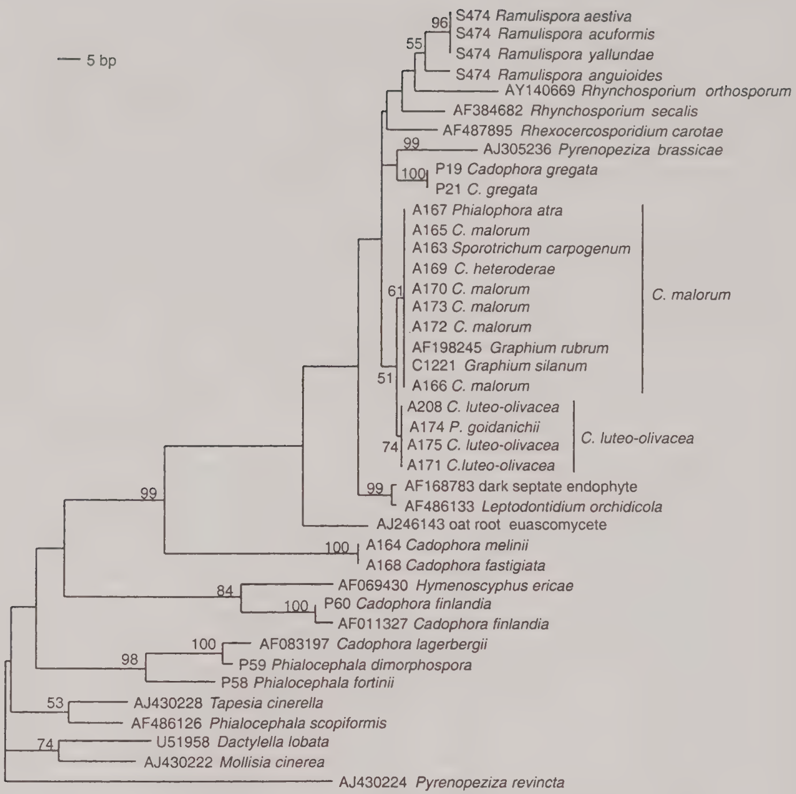

5 bp
96
55
S474 Ramulispora aestiva
S474 Ramulispora acuformis
S474 Ramulispora yallundae
S474 Ramulispora anguioides
AY140669 Rhynchosporium orthosporum
AF384682 Rhynchosporium secalis
AF487895 Rhexocercosporidium carotae
99
AJ305236 Pyrenopeziza brassicae
100
P19 Cadophora gregata
P21 C. gregata
A167 Phialophora atra
A165 C. malorum
A163 Sporotrichum carpogenum
A169 C. heteroderae
61
A170 C. malorum
A173 C. malorum
A172 C. malorum
AF198245 Graphium rubrum
C1221 Graphium silanum
51
A166 C. malorum
C. malorum
A208 C. luteo-olivacea
A174 P. goidanichii
74
A175 C. luteo-olivacea
A171 C.luteo-olivacea
C. luteo-olivacea
99
AF168783 dark septate endophyte
AF486133 Leptodontidium orchidicola
AJ246143 oat root euascomycete
99
100
A164 Cadophora melinii
A168 Cadophora fastigiata
84
AF069430 Hymenoscyphus ericae
100
P60 Cadophora finlandia
AF011327 Cadophora finlandia
100
AF083197 Cadophora lagerbergii
98
P59 Phialocephala dimorphospora
P58 Phialocephala fortinii
53
AJ430228 Tapesia cinerella
AF486126 Phialocephala scopiformis
74
U51958 Dactylella lobata
AJ430222 Mollisia cinerea
AJ430224 Pyrenopeziza revincta

Fig. 2. The most parsimonious tree based on the sequence of ITS1, ITS2 and the 5.8s gene of the rDNA of *Cadophora* and related Helotiales. Bootstrap values greater than 50% are indicated above the branches. The tree is rooted to *Pyrenopeziza revincta*. Isolate numbers (Table 1) or accession numbers for DNA sequences are given for each taxon. Sequences for *Ramulispora* spp. are from TreeBASE.

The ITS sequences of three other *Phialophora* species (*P. calyciformis*, *P. richardsiae* and *P. brunnescens*) were similar to each other, but these sequences could not be reasonably aligned with those of the *Cadophora* species. A BLAST search with the ITS sequence of *P. brunnescens* showed that the nearest sequences were those of *P. mustea* Neerg. (AF083194), *P. richardsiae* (PRU31844), and *P. repens* (David.) Conant (AF083195). No ITS sequence of a teleomorph matched closely with those of the *Phialophora* species.

TAXONOMY

Cadophora Lagerb. & Melin, *Svenska Skogsvärdsfören. Tidskrift.* 25:263. 1927.

Cadophora fastigiata Lagerb. & Melin, *Svenska Skogsvärdsfören. Tidskrift.* 25:263. 1927.
≡ *Phialophora fastigiata* (Lagerb. & Melin) Conant, *Mycologia* 29:598. 1937.

Cadophora fastigiata was described from Sweden on blue-stained pine wood (Lagerberg & Melin 1927), but no living culture of their material is available. Isolate CBS 307.49 from blue-stained wood in Sweden is thought to be representative of the species, and Schol-Schwartz (1970) noted no morphological differences between this culture and the type specimen for *C. fastigiata*. The ITS sequence of CBS 307.49 was identical to that of the isolate from the holotype of *C. melinii*, although in gross morphology the cultures look different.

Cadophora finlandia (Wang & Wilcox) Harrington & McNew, comb. nov.
≡ *Phialophora finlandia* Wang & Wilcox, *Mycologia* 77:953. 1985 (basionym).

The ITS sequences of two isolates of *C. finlandia* were similar to each other and near that of *Hymenoscyphus ericae*. Both species are associated with plant roots.

Cadophora gregata (Allington & Chamberlain) Harrington & McNew, comb. nov.
≡ *Cephalosporium gregata* Allington & Chamberlain, *Phytopathology* 38:797. 1948 (basionym).
≡ *Phialophora gregata* (Allington & Chamberlain) W. Gams, Cephalosporium-Schimmelpilze (Hyphomycetes) p.199. 1971.

This species causes brown stem rot of soybean (*C. gregata* f. sp. *sojae*) and adzuki bean (*C. gregata* f. sp. *adzukicola*). No teleomorph has been discovered, but LSU rDNA analysis had previously placed the fungus in the Helotiales (Paulin and Harrington 2000).

Cadophora lagerbergii Melin & Nannf., *Svenska Skogsvärdsfören. Tidskrift.* 32:415. 1934.
≡ *Phialophora lagerbergii* (Melin & Nannf.) Conant, *Mycologia* 29:598. 1937.

The ITS sequence of this species places it close to two species of *Phialocephala*, which have phialides on top of metulae at the top of a stalked conidiophore (Crane 1971). No such metulae or stalk has been noted with *C. lagerbergii*. The culture (CBS 266.33) from which the ITS sequence (AF083197) was derived was from the holotype of *C. lagerbergii*, which was associated with blue-stained wood.

Cadophora luteo-olivacea (van Beyma) Harrington & McNew, comb. nov.
≡ *Phialophora luteo-olivacae* van Beyma, *Antonie van Leeuwenhoek* 6:280. 1940 (basionym).
=*Phialophora goidanichii* Delitala, *Ann. Sperim. Agric. Roma*, N. S. 6:254. 1952

In morphology, biology and ITS sequence this species is close to *C. malorum*. Schol-Schwarz (1970) considered *P. luteo-olivacea* and *P. goidanichii* synonyms for *P. malorum*, but the ITS sequence data separates the first two from *C. malorum*. The culture of *P. goidanichii* used for ITS sequencing is from the holotype.

Cadophora malorum (Kidd & Beaum) W. Gams, *Stud. Mycol.* 45:188. 2000.
≡ *Sporotrichum malorum* Kidd & Beaum., *Trans. Brit. Mycol. Soc.* 10:111. 1924.
≡ *Phialophora malorum* (Kidd & Beaum.) McColloch, *Phytopathology* 32:1094. 1942.
= *Phialophora atra* van Beyma, *Antonie van Leeuwenhoek* 8:114. 1942.
= *Sporotrichum carpogenum* Ruehle, *Phytopathology* 21:1144. 1931.
= *Cadophora heteroderae* van Beyma, *Zentbl. Bakt. Parasitkde.* (Abt. II), 96:430. 1937.

Numerous synonyms were proposed for *C. malorum* by Schol-Schwarz (1970), a soilborne or wood-associated species that may also rot apple fruit. We were able to generate ITS sequences for cultures authentic for the type or from the holotype of each the proposed synonyms. With the exception of *C. luteo-olivacea* and *P. goidanichii*, ITS sequence analysis confirmed the synonyms proposed by Schol-Schwarz (1970), and those synonyms are reiterated above.

The ITS sequences of *Graphium rubrum* and *G. silanum* are also identical to that of *C. malorum*. Although the culture of *G. rubrum* is reported to be from the holotype, there is some doubt if the culture does indeed represent the species (Harrington *et al.*, 2001). A similar problem seems to exist for the culture of *G. silanum* (Harrington *et al.*, 2001).

Cadophora melinii Nannf., *Svenska Skogsvärdsfören. Tidskrift.* 32:417. 1934.
≡ *Phialophora melinii* (Nannf.) Conant, *Mycologia* 29:598. 1937.

The possibility that *C. melinii* is a synonym of *C. fastigiata* was discussed above. The sequenced *C. melinii* culture was from the holotype.

DOUBTFUL OR EXCLUDED SPECIES:

Phialophora americana (Nannf.) S. Hughes, Can. J. Bot. 36:795. 1958.
≡ *Cadophora americana* Nannf., *Svenska Skogsvärdsfören. Tidskrift.* 32:412. 1934.

The LSU analysis using the sequence of a culture of *P. americana* placed this species near *Capronia pilosella* in the Chaetothyriales, and *P. americana* has been connected to *C. semiimmersa* (Candoussau & Sulmont) Untereiner & Naveau (Untereiner & Naveau 1999). *Phialophora americana* is morphologically similar to *P. verrucosa*, the type species of *Phialophora*.

Phialophora brunnescens (David.) Conant, *Mycologia* 29:598. 1937.
≡ *Cadophora brunnescens* Davidson, *J. Ag. Res.* 50:803. 1935.

The ITS sequence (AY249079) of the culture from the holotype showed this species to be closely related to *P. calyciformis* and *P. richardsiae*, which were shown to have affinities to the Sordariomycetes based on LSU analysis (Fig. 1).

Phialophora obscura (Nannf.) Conant, *Mycologia* 29:598. 1937.
≡ *Cadophora obscura* Nannf., *Svenska Skogsvärdsfören. Tidskrift.* 32:419. 1934.

We did not study a culture of *P. obscura*, but Schol-Schwartz (1970) examined the culture from the holotype and synonymized this species with *Phialophora bubakii* (Laxa) Schol-Schwartz (≡ *Margarinomyces bubaki* Laxa). It is unclear if these species have Helotialian affinities or not. Gams (2000) considered *Margarinomyces* among the "unclassified" phialophora-like genera.

Phialophora repens (David.) Conant, *Mycologia* 29:598. 1937.
≡ *Cadophora repens* Davidson, *J. Ag. Res.* 50:803. 1935.

An ITS sequence (AF083195) from isolate CBS 294.39 (an isolate from the holotype) shows it to be most similar to *P. mustea,* and the ITS sequences of *P. brunnescens*, *P. calyciformis* and *P. richardsiae* are also similar to that of CBS 294.39. As discussed above, these *Phialophora* species appear to have affinities to the Sordariomycetes.

Phialophora richardsiae (Nannf.) Conant, *Mycologia* 29:598. 1937.
≡ *Cadophora richardsiae* Nannf., *Svenska Skogsvärdsfören. Tidskrift.* 32:421, 1934.

The LSU sequence of a culture from the holotype showed its affinities to *P. calyciformis* and the Sordariomycetes, perhaps near the Diaporthales.

DISCUSSION

We are following Gams' suggestion for the use of the generic name *Cadophora* for phialophora-like species with affinities to the Dermateaceae in the Helotiales. A morphological definition of the genus will be difficult, however. Gams stated that " . . . while the vegetative hyphae in these species are more or less pigmented, the phialides are pale to hyaline, particularly the collarettes." However, pigmentation in these species is often quite variable, and diagnostic characters for *Cadophora*, other than molecular, are unclear at this time. The known *Cadophora* species and their relatives appear to be plant pathogens, root associates, or colonizers of wood.

The rDNA sequence analyses support Gams' (2000) grouping of *Cadophora fastigiata*, *C. melinii* and *C. malorum* with the Dermateaceae of the Helotiales and distinct from true *Phialophora* species, which are anamorphs of the Chaetothyriales. However, his inclusion of *P. repens* in the *Cadophora* group was not supported by ITS sequence analysis. This and some other species named in *Cadophora* were shown to have affinities to the Sordariomycetes or the Chaetothyriales.

Even among the Dermateaceae and among the other families of the Helotiales, there are several anamorphic genera of similar morphology, and a natural system of classification of these anamorphs may be impossible. *Cadophora lagerbergii* had an ITS sequence very similar to *Phialocephala fortinii* and *P. dimorphospora*, which have stalked conidiophores. The other *Cadophora* species tended to group closely to each other, but the anamorphic genera *Ramulispora*, *Rhynchosporium* and *Rhexocercosporidium* also are found among *Cadophora* species based on our ITS analysis. These anamorphic genera have sporodochia or stromatic tissue from which septate conidia are produced. *Tapesia acufomris* and *T. yallundae* have *Ramulispora* anamorphs (Stewart *et al.*, 1999), and earlier analyses of rDNA sequences (Goodwin 2002) found that *Ramulispora* and *Rhynchosporium* are related to the teleomorphic *Tapesia* and *Pyrenopeziza brassicae*.

The anamorphic genera *Dactylella* and *Leptodontium* are morphologically distinct from *Cadophora,* but ITS sequences suggest some relationship. The recently described genus *Cantenulifera* Hosoya (Hosoya 2002) for anamorphs of *Hyphodiscus* Kirschst. (Dermateaceae) appears to be synonymous with *Cadophora*.

As recently reviewed by Goodwin (2002), the family status of many genera within the Helotiales is not clear, particularly those genera placed in the Dermateaceae. In our ITS tree *Tapesia* and *Pyrenopeziza* species are found among the *Cadophora* species. *Mollisia* may be a synonym of *Tapesia* (Goodwin 2002), but the ITS sequences of *M. cinerea* and *T. cinerella* were more distant from the sequences of the *Cadophora* species than were the sequences of *T. yallundae* and *T. acuformis*. *Pyrenopeziza brassicae* had an ITS sequence similar to that of the *Cadophora* species, but the ITS sequence of *P. revincta* was distinct. Although *Hymenoscyphus* is classified by some as a member of the Helotiaceae, the LSU and ITS sequences of *H. ericae* place it among the *Cadophora* species, *Tapesia*, and *Pyrenopeziza brassicae*.

Caution must be exercised in the interpretation of our ITS tree because much of the ITS1 and ITS2 regions contains numerous insertions and deletions, and the sequences are very difficult to align without ambiguity. Also, many of these sequences were from other sources, and it is difficult to know if the isolates from which these sequences were derived were correctly identified. However, most of the *Cadophora* species were represented by isolates from the respective holotypes, and both the LSU and ITS sequences of these isolates clearly place the *Cadophora* species in the Helotiales, particularly close to the those species of *Tapesia*, *Pyrenopeziza* and *Hymenoscyphus* that we analyzed.

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DICHOTOMOPHTHORA PORTULACAE ON PORTULACA OLERACEA IN TURKEY

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ABSTRACT

Dichotomophthora portulacae on *Portulaca oleracea*, a fungus species new for the Turkish mycoflora, is described briefly and illustrated. In pathogenicity tests, *D. portulacae* was found to be highly pathogenic to purslane plants.

Key words: purslane, crown rot, root rot, pathogenicity

INTRODUCTION

Although purslane (*Portulaca oleracea* L.) is commonly regarded as a troublesome garden weed, it is extensively consumed as a succulent food crop and used for medicinal purposes in the world. Purslane has been reported to be the richest vegetable source of omega-3 fatty acid, and it also contains high levels of vitamins E, C and beta carotene (Simopoulos, 1991; Ezekwe et al., 1999). *Dichotomophthora portulacae* Mehrl. & Fitzp. ex M. B. Ellis, is a soilborne pathogen, attacks the stems and leaves of purslane (Merhlich and Fitzpatrick, 1935; Ellis, 1971; Klisiewicz et al., 1983; Mitchell, 1986).

A crown and root rot of cultivated purslane was observed in Erzurum, Turkey, during the summer of 2002 (Figure 1). The present paper reports the etiology of the disease.

MATERIALS AND METHODS

Cultivated purslane plants showing symptoms of crown and root rot were collected from two districts (Center and Ilıca) of Erzurum. Diseased plants were washed under running tap water, surface disinfected for 1 minute with % 1 NaOCl and rinsed in three changes of sterile distilled water. Crown and root pieces cut from the periphery of lesions were plated on potato dextrose agar (PDA). The plates were incubated at 25 °C in the dark for five days, and then isolates were identified according to the Ellis (1971). Single- spore cultures of selected isolates were transferred to PDA medium in tubes for preservation at 4 °C.

Slides were prepared from 10-day-old cultures. The pathogen was characterized by observing their reproductive structures (sclerotia, conidiophores and conidia) and taking the measurements of 100 sclerotia, conidiophores and conidia. On the other hand, the number of septa in the conidia was also recorded.

An agar plate assay modified from Eken and Demirci (2003) was used to determine the pathogenicity. A 6-mm-diameter disk, which removed from the edge of a 7-8 days old colony growing on PDA was placed on to the center of a 9 cm-diameter petri plate containing 1.5 % water agar (WA) and incubated at 25 °C for 5 days. Then twenty-five purslane seeds, which disinfected in % 1 NaOCl for 5 minutes and dried in a sterile paper towel were spaced equidistantly in a radiate pattern on to the surface of the cultures with an aid of vacuum template. Cultures were incubated in growth chambers at 25 °C for 8 days under a 12 h dark/12 h light regime. According to germination of the seeds, the results were evaluated.

A randomly selected single spore isolate was used to inoculate 3-week-old purslane plants. Purslane seeds, which surface-disinfected as described before were sown into 125 mm plastic pots containing steam-sterilized soil. Plants were thinned to 5 plants per pot. Spore suspension was prepared from 10 days old PDA cultures held at 25 °C under 12 h dark / 12 h light regime and adjusted to 5×10^4 conidia/ml. Tween 20 at rate of two drops per 100 ml was added and the suspension was sprayed onto 3-week-old seedlings until run off. Control plants were sprayed with distilled water. Inoculated and control plants were placed in a glasshouse at 20 °C and seedlings were enclosed in plastic bags for 2 days. Disease symptoms were recorded after seven days and reisolations were made.

RESULTS

Over 100 isolations were made from crown and root rot of the naturally infected purslane plants collected from Erzurum. Only one species was isolated from all lesions and it was identified as *Dichotomophthora portulacae* Mehrl. & Fitzp. ex M. B. Ellis by using the procedure of Ellis (1971).

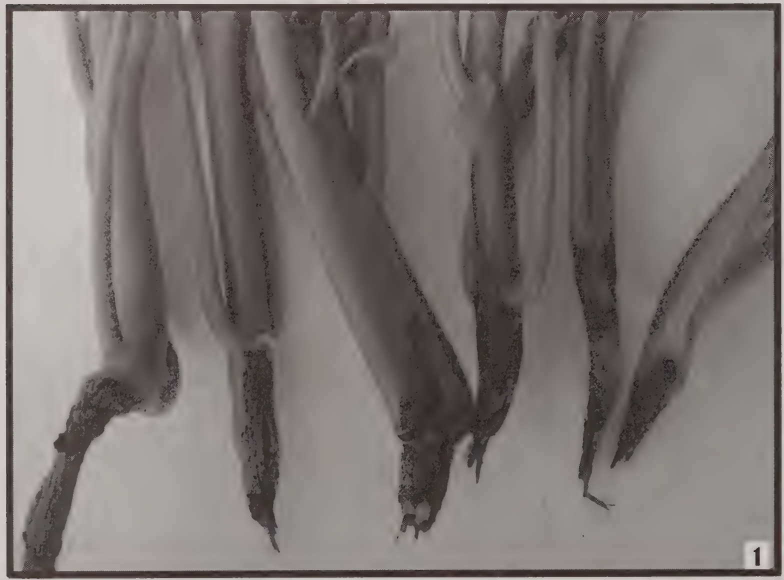

Figure 1. Diseased purslane plant showing typical crown and root rot symptoms.

Colony on the PDA, grayish brown, to dark olivaceous, velvety. Sclerotia abundant, dark brown to black, variable in shape, (110-) 245 (-580) µm x (90-) 207 (-350) µm. Conidiophores brown, simple or regularly dichotomously branched or lobed at the apex (4-8), each lobe bearing a single conidium, (180-) 451,8 (-750) µm, (3,8-)

8,1 (-12,5) µm in thickness at the base, (5-) 10,4 (-17,5) µm at the apex (Figure 2A). Conidia dark, ovoid to elongate-ovoid, or cylindrical, 0-6 septate, measuring (µm): 0-sept. (12-) 15,3 (-22) x (5-) 9,7 (-13), 1- sept. (14-) 21,1 (-28) x (7-) 9,1 (-12), 2- sept. (22-) 31,9 (-44) x (7-) 9,7 (-12), 3- sept. (34-) 45,9 (-60) x (8-) 11,1 (-14), 4- sept. (33-) 58,5 (-70) x (10-) 12,2 (-16), 5- sept. (56-) 62,9 (-71) x (11-) 12,5 (-14), 6- sept. (68-) 76,5 (-84) x (12-) 12,8 (-13) (Figure 2B).

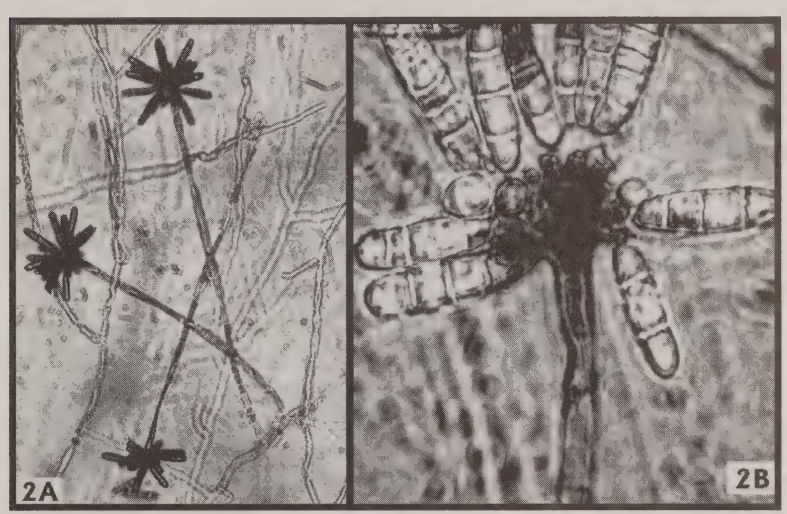

Figure 2. *Dichotomophthora portulacae*; conidiophores (A-x100) and conidia (B-x500).

D. portulacae was induced seed rot and postemergence damping-off symptoms within eight days (all seedlings died).

D. portulacae was found to be pathogen on the foliage of purslane plants. Necrotic sunken lesions became evident on leaves and stems within the forty-eight hours of inoculation. Infected leaves turned to yellow and dropped. Dark lesions developed at stem, resulting in dieback. All the inoculated seedlings were died within seven days. *D. portulacae* was reisolated from dead seedlings.

DISCUSSION

D. portulacae was reported as a pathogen of *P. oleracea* in Hawaii, Jamaica, Sudan, Venezuela, California and Texas (Merhlich and Fitzpatrick, 1935; Ellis, 1971; Klisiewicz et al., 1983; Mitchell, 1986). This is the first report of *D. portulacae* associated with a disease of purslane from Turkey. *D. portulacae* was found to be highly pathogenic to purslane plants. The results of our studies indicate that the agar-plate method is useful for studying the pathogenicity of *D. portulacae* that causes damping-off symptoms on purslane seedlings. Klisiewicz et al. (1983) reported that *D. portulacae* might more likely to be lethal if purslane plants were infected at a young age. Results of foliar inoculations confirmed the previous studies showing that *D. portulacae* was highly pathogenic to the foliage and stems of purslane (Ellis, 1971; Klisiewicz et al., 1983; Klisiewicz, 1985; Mitchell, 1986).

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CONCERNING PHOMOPSIS GOSSYPII, THE CAUSAL ORGANISM OF BOLL ROT OF COTTON

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ABSTRACT

Phomopsis gossypii, the coelomycetous anamorph causal organism of boll rot and other diseases of cotton, is recharacterized, described, illustrated and compared with certain other *Phomopsis* species. Its taxonomic and nomenclatural history is reviewed, as are aspects of its symptomatology. The basionym of this taxon is recombined since a previous transfer thereof was invalidly published. Some account of host/pathogen relationships is also included. Commentary is made on the systematics of the *Phomopsis*-complex, particularly with regard to better defining species.

KEYWORDS: *Gossypium hirsutum, Diaporthe*, ITS, genetic distance, cultural features, species concepts

INTRODUCTION

A coelomycetous anamorph belonging to the large genus *Phomopsis* (Sacc.) Bubák, an entity which contains well over a thousand binomials, many of which are based primarily on host associations, has been known to exist on upland cotton [*Gossypium hirsutum* L.] for well over a century. It has been implicated in various diseases of its host, including a necrotic leaf-spot disorder and premature boll rot (Ivey and Pinckard, 1967; McLean and Lawrence, 1998). In spite of this, its taxonomy and nomenclature remain in an unsatisfactory state due in large part to a lack of fully adequate characterization of its morphology *in vivo* and its colony growth and appearance peculiarities *in vitro*. There has also been some volatility and confusion in the matter of application of names and their validity. From the very beginning in fact, the presence of two types of conidia, and lack of realization thereof, led to a veritable taxonomic jumble. In addition, perhaps surprisingly, given the long-time economic importance of the plant on which it occurs and the disease symptoms which it induces, there has been comparatively little documentation in the literature of the exact nature of the host/pathogen relationship.

The first name ever applied to the *Phomopsis* occurring on cotton was *Septoria* (*Phlyctaena*) *arcuata* Berk.**gossypii* Sacc. [*Michelia* 2:144, 1880]. When so doing, Saccardo (1880), who had in hand a specimen on stems collected in South Carolina by H.W. Ravenel, in effect presumably considered the anamorph to be a variety or form of *Phlyctaena arcuata* Berk. This species had been described earlier by Berkeley [*Grevillea* 2:100, 1874] from material on dead stems of *Solidago* originating in New England. In arriving at the decision to thus classify it, Saccardo (loc. cit.) evidently observed only the β conidia, a fact readily apparent from his description, where the conidia were said to be 'filiformibus, sursum uncinatis 25-30 X 1-1 $^{1}/_{4}$'. An added note indicated Saccardo's opinion that this entity approximated *Septoria phomatella* Sacc. Toward the bottom of the same *Michelia* page [144] on which the above was published Saccardo named and described another fungus from cotton, namely *Phoma* (*Diap.*) *gossypii* Sacc. This was also based on stem material obtained from H.W. Ravenel, which might well have been part of the same collection. From his description it is abundantly evident that Saccardo established this name for the α conidial form of the same anamorph. The conidia were described as being 'breve fusoides, 8 X 2, 2-guttulatis', a give-away insofar as identity is concerned. A note which reads 'in caule Gossypii, socia *Septoria arcuata'* followed the description. Saccardo evidently managed to publish two names and provide two descriptions, on the same page, for a single pycnidial anamorph.

In a subsequent publication (Saccardo, 1884), the pycnidial anamorph from cotton bearing filiform uncinate conidia was given the status of a separate species, as *Phlyctaena gossypii* Sacc. [this, in actuality, constituted a transfer, a new combination, where a previously published varietal name was effectively elevated and the binomial should therefore be cited as *Phlyctaena gossypii* (Sacc.) Sacc.]. (The correct spelling of this generic name is, incidentally, *Phlyctema* [see Sutton (1977]). At the same time, Saccardo maintained the name *Phoma gossypii* Sacc. [*Syll. fung.* 3:121, 1884] for the fusoid, bi-guttulate α conidial state, adding again that it was found in association with *Septoria arcuata* [i.e.*Phlyctaena gossypii* [*Syll. fung.* 3:595, 1884; (*Phlyctaena arcuata* was treated separately on the same page)]. He noted also that it was the 'spermogonium' of a *Diaporthe*.

Application of the name *Phlyctaena gossypii* [as *Phlyctaena gossypii* Sacc.] to collections of the cotton *Phomopsis* continued for over eighty years until Montegut (1967) recognized that it did not belong in *Phlyctema* Desm. [as *Phlyctaena*]. The type species of that genus, *Phlyctema vagabunda* Desm., [see von Arx (1957, 1970) and Sutton (1980)] is a rather different coelomycetous anamorph whose conidiomata, though similarly eustromatic, are essentially sporodochial in nature and its conidia are narrowly fusiform rather than long filiform, as are the β conidia of *Phomopsis*. The first missspelling of *Phlyctema,* by the way, can be attributed to Montagne (1849) who, two years after the genus was established by Desmazières [*Ann. Sci. nat.*, ser. 3,8:16, 1847], named a new species *Phlyctaena buffoniae* Mont., and referred to the type species of the genus as *Phlyctaena vagabunda*. The orthographic error, assuming that it was unintentional, was subsequently perpetuated by numerous authors, including Saccardo. In making the new combination *Phomopsis gossypii* (Sacc.) Montegut [basionym *Phlyctaena gossypii* Sacc.] an acceptable and cogent taxonomic action was implemented but, unfortunately, this transfer was invalidly published since a full and direct reference to the original place of publication of the basionym, with page and date, as required on or after 1 January 1953 by the ICBN, was not given.

In the same year, Ivey and Pinckard (1967), in their own words, tentatively gave the *Phomopsis* entity on cotton the binomial *Phomopsis gossypii* but without reference to any previously existing basionym. Moreover, no description was provided nor was any type designated. The name which they proposed is, therefore, in effect, a *nomen nudum*. Since the binomial *Phomopsis gossypii* has, therefore, never been validly published and, in terms of nomenclatural legitimacy, does not technically exist, a new transfer of *Septoria arcuata* var. *gossypii* is made herein.

During the course of studying a disease complex of cotton stems and branches in Mali, west Africa, Montegut (loc.cit.) encountered the anamorph to which he gave the name *Phomopsis gossypii.* This, together with *Macrophomina phaseolina* (Tassi) Goidanich [as *M. phaseoli* (Maubl.) S. Ashby] and an unnamed *Phoma* sp. [probably *Phoma glomerata* (Corda) Wollenweb. & Hochapfel., judging from the published illustration and particularly the presence of an *Alternaria*-like chlamydospore state] were referred to as secondary agents of a disease primarily induced by *Cercospora lhuillieri* Montegut, a newly described species. Morphological characterization of the *Phomopsis* was provided, together with an account of cultural characteristics. Both α and β conidia were described. Montegut's treatment remains the only moderately definitive documentation of the characteristics of this taxon existing to date in the literature.

Studies on the genus *Phomopsis* conducted within the past decade (Rehner and Uecker, 1994; Zhang *et al.*, 1998; Farr *et al.*, 1999, 2002) have repeatedly laid emphasis on the desirability of improving the means by which species are recognized and defined. In the process of attempting to make meaningful progress in this regard, it has become very evident, however, that refining its taxonomy offers a number of challenges, in part reflecting the complexity of this large entity and the fact that the host specificity factor is not necessarily always indicative of genetic distance and discontinuity. It has been shown that sequence analysis of internal transcribed spacer (ITS) regions of the nuclear ribososomal DNA of *Phomopsis* isolates, especially when coupled with morphological and cultural characteristics, may help identify more or less discrete taxa but phylogenetic relationships across a range of species clearly cannot be determined with great confidence. It has been concluded [see Farr *et al.* (2002)] that analysis of multiple genes will be required before a clear picture of overall phylogenetic relatedness among species of *Phomopsis* can be obtained.

While conducting a study of fungi colonizing various tissues of upland cotton, including bolls, leaves, petioles and roots (Palmateer *et al.*, 2003), a *Phomopsis* anamorph was repeatedly encountered by the present authors. Tissue samples originiating from a number of widely-dispersed locations in the cotton-growing areas of Alabama, U.S.A., were surveyed. Acquisition of numerous isolates of this entity afforded an opportunity to reconsider the taxonomy and characterization of what has been known hithertofore as either *Phomopsis gossypii* or *Phomopsis* sp. Interestingly, both Baird (2001) and Batson (2001) referred to one of the causal organisms of leaf spot and boll rot of cotton, respectively, as *Phomopsis* sp., indicating that there has remained some doubt as to name application. In order to more adequately characterize this anamorph and to determine its possible distinctiveness, and its relatedness to other *Phomopsis* species, including *P. longicolla* Hobbs and *P. phaseoli* (Desm.) Grove, which occur on soybean, study of its conidiomatal morphology, conidial size, and colony growth peculiarities *in vitro*, were conducted and ITS rDNA sequencing data were generated and considered.

Particularities of the host/pathogen relationship between this *Phomopsis* anamorph and cotton appear, up to the present time, to be rather imperfectly known. Although, as mentioned above, some of the induced symptoms have been variously described (Ivey and Pinckard, loc.cit.; McLean and Lawrence, loc.cit.), the probable systemic nature of the causal agent (Palmateer and McLean, unpublished data) has not been previously reported. Evidence suggests that this organism is widespread in cotton-growing areas of the southeastern United States where it contributes to economic losses attributable to boll rot.

MATERIALS AND METHODS

Isolates of *Phomopsis* used in this study were obtained from cotton tissues collected in six Alabama counties, extending from Limestone County in the north to Baldwin County in the extreme south. For comparative purposes, *Phomopsis* isolates were obtained from soybean [*Glycine max* (L.) Merr.] collected in Alabama, Louisiana and Mississippi [see Table 1]. Immediately after plants were collected, they were sealed in plastic bags and stored on ice prior to examination. Plant samples were subsequently washed in running tap water for 15 min, following which one 5-mm section was excised from the roots, petioles, and leaves of each plant. Cotton bolls were also included. Plant tissues were surface sterilized in 95% ethanol followed by 0.10% sodium hypochlorite (NaOCl). Surface sterilized roots, petioles, leaves, bolls, and pods were then aseptically plated on acidified potato dextrose agar (APDA). The plates were incubated at 25 C for 3 to 10 days. *Phomopsis* isolates were selected from the mycelium growing out from the plant tissues. All isolates were maintained on Difco potato dextrose agar (PDA) slants. To determine the morphology *in vivo* of the *Phomopsis* occurring on cotton certain herbarium specimens were examined.

For growth studies, mycelial plugs 3 mm in diameter taken from 4 day old *Phomopsis* cultures growing on PDA were placed in the center of 100 mm Petri dishes. Cultures were grown on PDA at 25 C in the dark for eight days. Colony diameter measurements in mm were obtained at 72 hours. Each isolate was replicated 4 times.

Nucleic acid extraction and PCR amplification

Mycelia were grown on Difco potato dextrose broth for four days at room temperature under ambient light conditions. Mycelia were harvested by vacuum filtration on Whatman No. 1 filter paper and freeze-dried prior to DNA extraction. DNA was extracted with the Dneasy Plant Mini Kit (Qiagen Inc., Chatsworth, California) according to the manufacturer's instructions using approximately 15 mg dried tissue. The internal transcribed spacer (ITS) regions 1 and 2, including the 5.8S rDNA, were amplified in 50 µL reactions on a GeneAmp 9700 thermal cycler (Applied Biosystems, Foster City, California) under the following reaction conditions: 10-15 ng of genomic DNA, 200 mM each dNTP, 2.5 units Amplitaq Gold (Applied Biosystems, Foster City, California), 25 pmoles each of primers ITS5 and ITS4 (White *et al.*, 1990) and the supplied 10X PCR buffer with 15 mM

TABLE 1. Isolates of *Phomopsis* used in this study.

Isolates	Host	Origin	Year
AJP78	*Gossypium hirsutum*	AL	1999
AJP79	*Gossypium hirsutum*	AL	1999
AJP2	*Gossypium hirsutum*	AL	2000
AJP4	*Gossypium hirsutum*	AL	2000
AJP17	*Glycine max*	AL	2000
AJP20	*Glycine max*	AL	2000
AJP24	*Gossypium hirsutum*	AL	2000
AJP25	*Glycine max*	AL	2000
AJP27	*Glycine max*	AL	2000
AJP28	*Glycine max*	AL	2000
AJP31	*Glycine max*	AL	2000
AJP32	*Glycine max*	AL	2000
AJP33	*Glycine max*	AL	2000
AJP34	*Glycine max*	AL	2000
AJP40	*Glycine max*	AL	2000
AJP44	*Gossypium hirsutum*	AL	2000
AJP56	*Glycine max*	AL	2000
AJP59	*Gossypium hirsutum*	AL	2000
AJP60	*Gossypium hirsutum*	AL	2000
AJP69	*Glycine max*	AL	2000
AJP57	*Glycine max*	AL	2000
AJP3	*Gossypium hirsutum*	AL	2001
AJP9	*Gossypium hirsutum*	AL	2001
AJP13	*Gossypium hirsutum*	AL	2001
AJP15	*Gossypium hirsutum*	AL	2001
AJP16	*Glycine max*	AL	2001
AJP37	*Glycine max*	AL	2001
AJP38	*Glycine max*	AL	2001
AJP39	*Gossypium hirsutum*	AL	2001
AJP41	*Gossypium hirsutum*	AL	2001
AJP43	*Gossypium hirsutum*	AL	2001
AJP53	*Gossypium hirsutum*	AL	2001
AJP1	*Gossypium hirsutum*	AL	2002
AJP45	*Glycine max*	LA	2000
AJP47	*Glycine max*	LA	2000
AJP48	*Glycine max*	LA	2000
AJP49	*Glycine max*	LA	2000
AJP52	*Glycine max*	LA	2000
AJP54	*Glycine max*	LA	2000
AJP55	*Glycine max*	LA	2000
AJP65	*Gossypium hirsutum*	LA	2001
AJP72	*Gossypium hirsutum*	LA	2001
AJP5	*Glycine max*	MS	1998
AJP6	*Glycine max*	MS	1998
AJP62	*Glycine max*	MS	1999
AJP77	*Gossypium hirsutum*	MS	1999
AJP80	*Gossypium hirsutum*	MS	1999
AJP8	*Glycine max*	MS	2000
AJP42	*Glycine max*	MS	2001

$MgCl_2$. The thermal cycler program was: 10 min at 95 C followed by 35 cycles of 30 s at 94 C, 30 s at 55 C, and 1 min at 79 C, with a final extension period of 10 min at 72 C. After PCR amplification, the products were purified with QIAquick columns (Qiagen Inc., Chatsworth, California) according to the manufacturer's instructions. The resulting amplified products were sequenced at the Auburn University Genomics facility.

Sequence Analysis

A total of forty-nine isolates representing the different taxa were selected for sequencing (Table 1). Sequences were edited using Squencher version 4.05 for Windows (Gene Codes Corporation, Ann Arbor, Michigan). Alignments were manually adjusted using Gene Doc 2.6001 and ambiguously aligned positions were excluded from the analyses. Phylogenetic analyses were performed with PAUP* 4.0b10. Methods included neighbor joining (NJ) (Kimura 2-parameter distance calculation), maximum parsimony (MP) using the heuristic search with 1000 random sequence input orders for exact solution and maximum likelihood (ML) using the model: GTR + G + I and empirical base frequencies A = 0.25403655, C = 0.254835098, G = 0.24952040 and T = 0.24809207, equal rates for all sites, NNI branch swapping and a transition / transversion ratio of 2.0. All unambiguously aligned characters were analyzed with the MULTREES option turned off to allow the search to go to completion. All molecular characters were unordered and given equal weight during analysis. For parsimony analysis gaps were treated as missing data. Gaps were ignored for maximum likelihood and neighbor joining analysis. The best topology was selected as the most parsimonious tree topology and evaluated with 1000 bootstrap replications to test the clade stability of the tree.

TAXONOMIC PART

Phomopsis gossypii (Sacc.) Palmateer, K.S. McLean & Morgan-Jones, *comb. nov.* (Figure 1).

≡ *Septoria arcuata* Berk. var. *gossypi* Sacc.,*Michelia 2:*144,1880.

≡ *Phlyctaena gossypii* (Sacc.) Sacc., Syll fung. 3:595, 1884.

≡ *Phomopsis gossypii* (Sacc.) Montegut, *Coton Fibr. trop.*, 22:451, 1967 [*nomen invalidum*].

= *Phoma gossypii* Sacc., *Michelia* 2:144, 1880.

= *Phomopsis gossypii* Ivey & Pinckard, *Phytopathology* 57:462, 1967 [*nomen nudum*].

Mycelium immersed, composed of branched, septate, subhyaline to pale brown, 2 to 3µm wide hyphae. Conidiomata eustromatic, most immersed but becoming partly or largely erumpent on stems when mature, with accompanying rupture of the host periderm, separate and scattered or gregarious, densely aggregated and sometimes confluent, brown to dark brown or black, irregularly globose to somewhat applanate and pulvinate in aspect, short rostrate, mostly unilocular or, more rarely, multilocular, often with a convoluted venter, thick-walled, up to fifteen cells thick, with the tissue mostly of a textura angularis type except for a relatively narrow subhymenial textura intricata zone and in the neck region where the cells tend to be smaller and more elongate, 200-350µm in diamater at the base, up to 250µm high. Conidiomatal wall cells subhyaline, thin-walled within but densely melanized and thick-walled toward the periphery except at the flat base. Conidiomatal necks 90-120µm long, broadly conic, with a circular ostiole, up to 90µm wide at the time of conidial egress in larger pycnidia. Conidiophores short, branched, 1- to 2-septate, hyaline, originating from cells lining the locules and forming a dense hymenium. Conidiogenous cells enteroblastic, phialidic, determinate, cylindrical to narrowly flask-shaped, bearing a very slightly flaring collarette, with moderate apical periclinal thickening resulting in a narrow conidiation channel. Conidia of two types: alpha conidia fusiform, straight, smooth, hyaline, biguttulate, aseptate, 6.5-8.5 X 2.5-3µm; beta conidia filiform, hamate, aseptate, 18-28 X 1µm.

On leaves and stems of *Gossypium hirsutum* L.; Africa and North America.

Colonies on PDA after ten days at 25°C floccose, dense, white to cream or very light peachy-pink [6A2 to 7A2 (Methuen Handbook of Color, A. Kornerup and J.H. Wanscher, Third Edition, Reprinted 1989)] in color, often becoming somewhat felted and reticulately funiculose with age, sometimes assuming a pale greenish-yellow hue in patches, indistinctly zonate, margin more or less even; reverse colorless or pale, cinnamon-brown, with distinctly undulate growth zones and scattered, variously shaped and sized, stromata evident. At 72 hours colonies 30 to 51 (38.5) mm in diameter.

Specimens examined: on stems of *Gossypium*, Petty, Texas, U.S.A., C.L. Shear, 11 March 1904, BPI; on stems of *Gossypium*, Nachitoches, Louisiana, U.S.A., 28 March 1904, BPI.

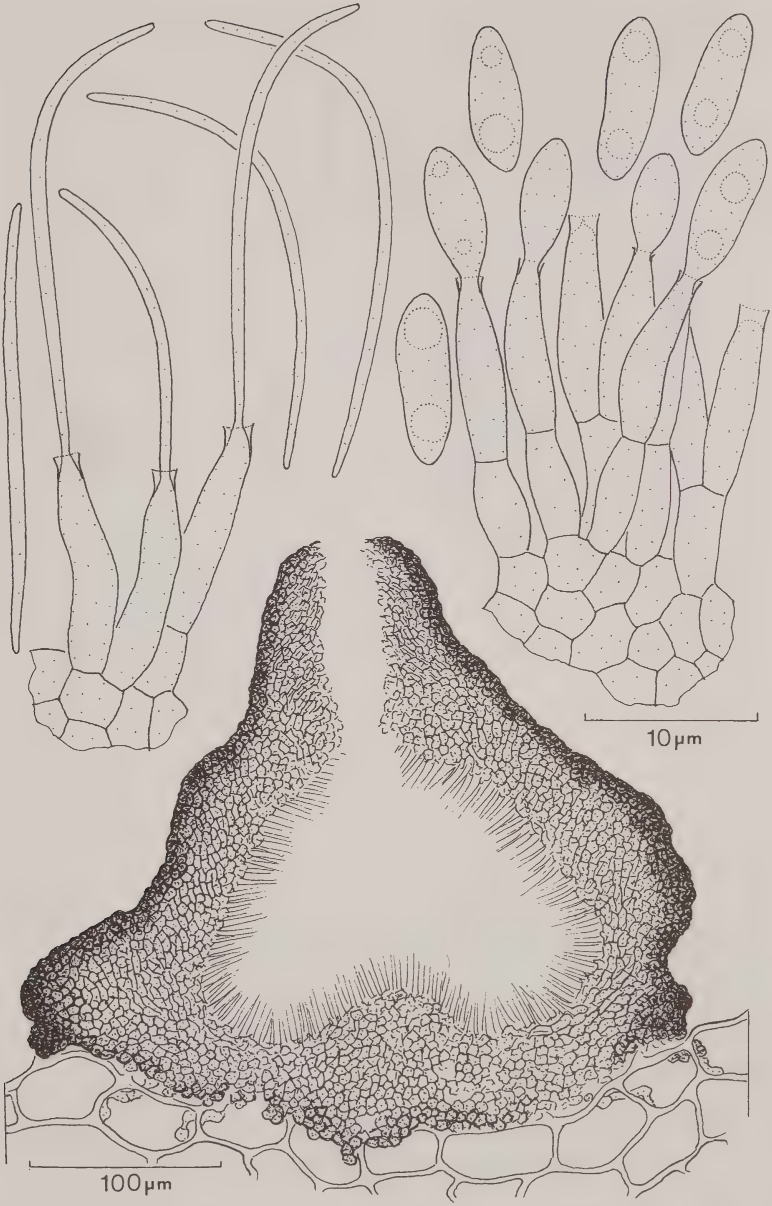
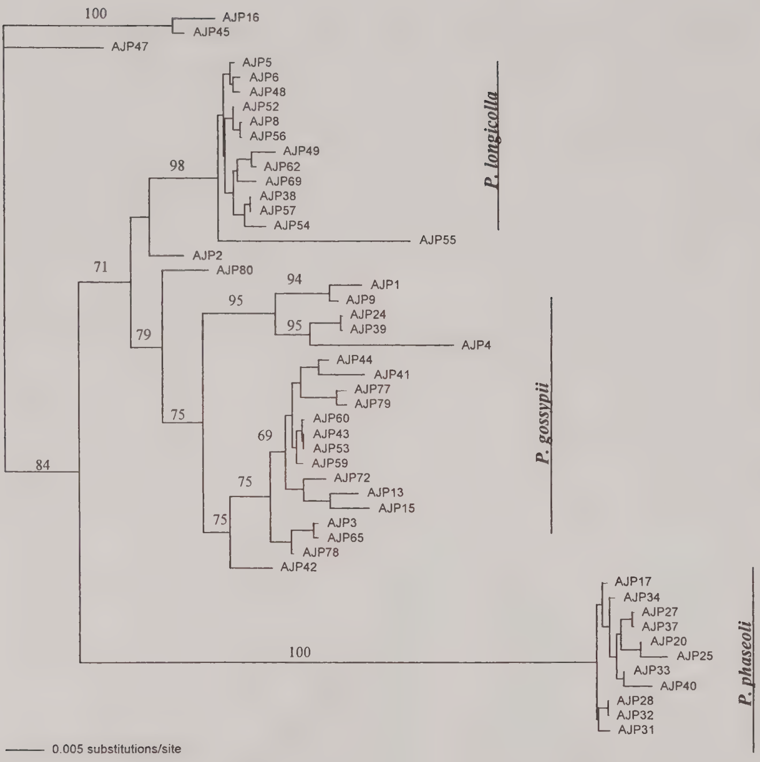


FIGURE 1. *Phomopsis gossypicola.* V.S. pycnidium, conidiophores and conidia.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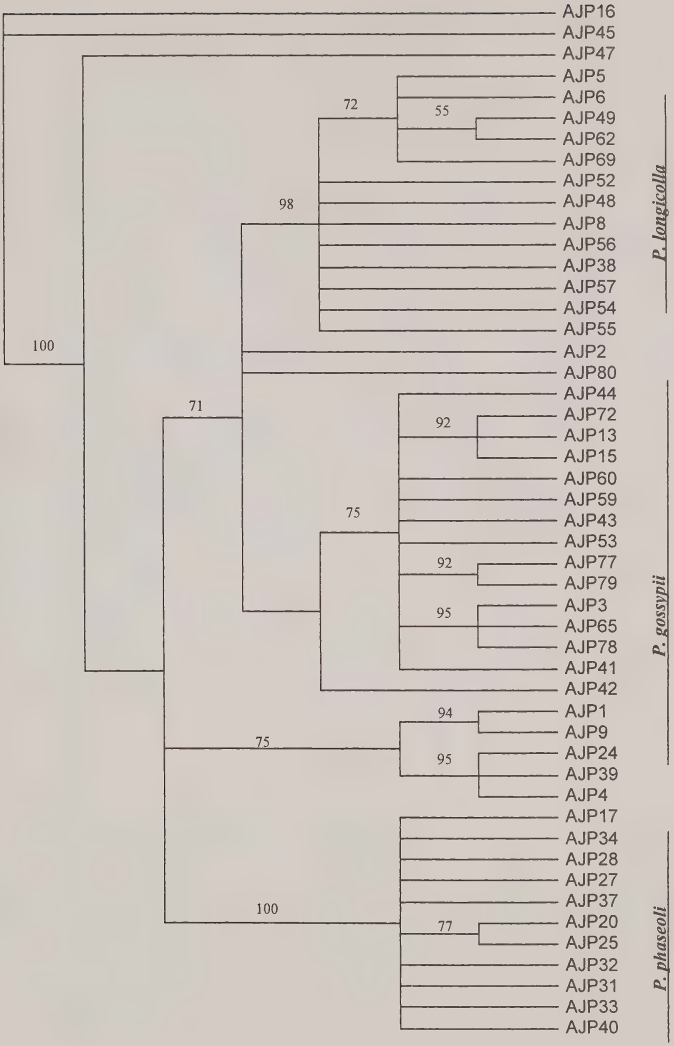
AJP57
AJP54
AJP55
P. longicolla
AJP2
71
AJP80
94
AJP1
95
AJP9
AJP24
95
AJP39
79
AJP4
AJP44
AJP41
AJP77
AJP79
75
AJP60
69
AJP43
AJP53
AJP59
P. gossypii
84
AJP72
75
AJP13
AJP15
75
AJP3
AJP65
AJP78
AJP42
AJP17
AJP34
AJP27
AJP37
AJP20
100
AJP25
AJP33
AJP40
AJP28
AJP32
AJP31
P. phaseoli
0.005 substitutions/site

FIGURE 2. Neighbor-Joining analysis ITS rDNA tree for *Phomopsis* isolates from *G. hirsutum* and *G. max*. Numbers above branches represent bootstrap support (1000 replicates each). Outgroup sequences are from isolates of *Diaporthe helianthi* isolated from *G. max*.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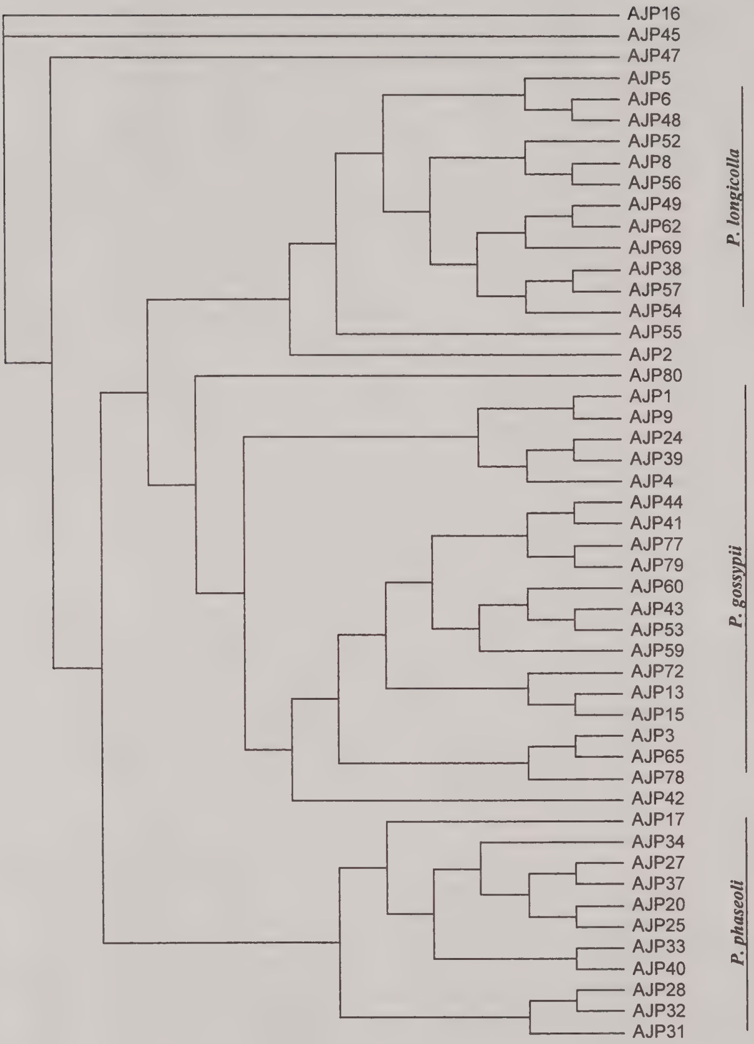
AJP25
AJP32
AJP31
AJP33
AJP40
72
55
98
100
71
92
75
92
95
94
75
95
100
77
P. longicolla
P. gossypii
P. phaseoli

FIGURE 3. Strict consensus of 130,000 most parsimonious trees of 231 steps (CI = 0.549) based on ITS rDNA sequences of *Phomopsis* isolates with MP bootstrap percentages above branches.


AJP16
AJP45
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AJP57
AJP54
AJP55
AJP2
AJP80
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AJP9
AJP24
AJP39
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AJP44
AJP41
AJP77
AJP79
AJP60
AJP43
AJP53
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AJP65
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AJP31
P. longicolla
P. gossypii
P. phaseoli

FIGURE 4. Maximum Likelihood analysis based on ITS r DNA sequences using the GTR + G + I model for *Phomopsis* isolates.

RESULTS

In this investigation, forty-nine isolates of *Phomopsis*, collected from two different hosts, *Gossypium hirsutum* and *Glycine max,* were studied [Table 1]. Those obtained from the latter were identified as either *P. longicolla* or *P. phaseoli* on the basis of their respective morphology and cultural characteristics. The isolates from *G. hirsutum* were determined to be *Phomopsis gossypii* following comparison between conidia produced in vitro and those formed within conidiomata in nature, as exemplified by the herbarium specimens examined. Phylogenetic trees which were generated using neighbor-joining, maximum parsimony, and maximum likelihood, displayed congruent topologies [Figures 2-4]. Maximum parsimony analysis of the ITS data, which was halted prematurely due to the large number of trees obtained, yielded 130,000 most parsimonious trees of 231 steps with a consistency index (CI) of 0.549. The tree topology appearing to be the more phylogentically definitive and informative was selected and evaluated, with 1000 bootstrap replications, and gave a final configuration that was compatible with accepted morphological delimitation of the taxa under consideration. Isolates of *P. longicolla* and *P. phaseoli,*collected from *G. max,* respectively clustered together with strong bootstrap support, indicating the presence of robust clades. The series of *Phomopsis* isolates originating from *G. hirsutum* did not group with any of those from *G. max.*

DISCUSSION

The isolation portion of this study has indicated that *Phomopsis gossypii* growth is systemic within its host since it is present in root tissue, as well as in aerial parts, of the cotton plants sampled. The most frequently encountered symptoms occur initially in immature structures, including young flower buds which sometimes fail to open. Developing cotton bolls and peduncles become progressively infected and eventually reach a necrotic condition. The primary and most economically important disease caused is, thereby, commonly referred to as premature boll rot. There is some indication that particular varieties are more susceptible than others, specifically those derived from Delta and Pine Land 90 (Robert Nichols, *in lit.*). Symptoms on stems and leaves may appear as sunken, water-soaked lesions. As the disease advances, pycnidia may be produced in various locations, particularly petioles. Eventually, late in the growing season, when plants are fully grown, developing conidiomata may occur in adundance on stems and, presumably, fulfill an overwintering function. In early spring, as favorable environmental conditions ensue, such conidiomata reach full maturity and conidiation occurs.

It has been observed (McLean and Lawrence, loc.cit.) that the ratio of alpha and beta conidia produced by pycnidia formed in axenic culture varies dependent upon the age of the colony. It is also apparent that, in nature, one or other of the two conidial types may predominate since in the herbarium specimens examined by the present authors conidiomata were found which contained numerous beta conidia but only very few alpha conidia. Among the isolates examined during the course of this study some young pycnidia formed in culture bore alpha and beta conidia in more or less equal numbers while in older conidiomata alpha conidia predominated. It is interesting in this context to note that when Saccardo (1884) applied the binomial *Phlyctaena gossypii* to this anamorph he presumably did so having encountered pycnidia containing only beta conidia, or at least those were the only type that he saw. A number of authors [see Pine (1957); Punithalingam (1979); Uecker (1988)] have noted that production of beta condia in *Phomopsis* can be variable and is influenced by a number of factors.

It is evident from morphological and cultural characteristics, as well as from analysis of ITS sequence data, that the *Phomopsis* entity occurring on cotton represents a distinct and readily distinguishable taxon. The relatively high level of bootstrap support for the group of isolates derived from this host certainly indicates a degree of separateness that justifies recognition at species level. As has been the case in some previous studies, such as those of Rehner and Uecker (1994), Uddin and Stevenson (1998) and Mostert *et al.* (2001), a combination of morphological, cultural, and molecular data makes possible more meaningful delimitation of taxa within *Phomopsis*. Added to this, physiological specialization, as reflected in host specificity, and pathogenicity factors provide further indication of distinctiveness. Quite clearly sibling species within this complex may have arisen, at least in part, through isolation in different hosts. This form of secondary, sympatric speciation is, presumably, not uncommon among plant-pathogenic anamorph genera such as *Phomopsis* and their teleomorph counterparts, in this case *Diaporthe* Nitschke.

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This study was made possible through the cooperation of several individuals, for which we are most grateful. Mr. John D. Mayfield, now at the Horticultural Sciences Department, University of Florida, Gainesville, provided advice and assistance with the laboratory portion of the molecular work. Dr. Jonathan W. Armbruster, Department of Biological Sciences, Auburn University, offered guidance with and facilitated the phylogenetic analyses. Dr. Amy Y. Rossman [BPI] made herbarium specimens available on loan. Dr. Richard P. Korf provided advice on matters nomenclatural. Dr. John M. McKemy, Animal and Plant Health Inspection Service, USDA, Beltsville, Maryland, provided a presubmission review of the manuscript.

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PSATHYRELLA ALBOFLOCCOSA, A NEW SPECIES OF SECTION CYSTOPSATHYRA

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Summary: *Psathyrella albofloccosa* is described as a new taxon. The abundant material collected was found growing in manured turf, fruiting in large groups. The species is characterized by whitish to pale buff colours of the basidiomata, presence of white conic spines forming the universal veil, capitate cheilocystidia and narrowly elliptical basidiospores.

Keywords: Agaricales, Coprinaceae, taxonomy

INTRODUCTION

Psathyrella (Fr.) Quél. section *Cystopsathyra* (Sing.) Kits van Wav. includes only eight species, three of them described from North America (SMITH, 1972), and the rest from Europe (GRÖGER, 1986; DELANNOY *et al*., 2002), though one of these, *P. ornatispora* M. Villarreal & Esteve-Rav. has been described from material collected in a greenhouse (ESTEVE-RAVENTÓS & VILLARREAL, 2002). *P. albofloccosa* has been found growing in a recently manured garden, and is easily recognized by the floccose whitish veil which covers the whole basidiomata in young stages.

MATERIAL AND METHODS

The description of *P. albofloccosa* has been made based on the examination of three collections containing numerous fresh basidiomata in different stages of development. Drawings were made with the aid of a camera lucida device. Spore measurements follow the method proposed by HEINEMANN & RAMMELOO (1985) and authors abbreviations are according to KIRK & ANSELL (1992). Colours are referred to MUNSELL (1994).

Psathyrella albofloccosa* Arenal, M. Villarreal & Esteve-Rav. *spec. nov. **(Figs. 1-7)**

Basidiomata gregaria. Primordia spinis albidis, conicis obtecta. Pileus 5-23 mm latus, primo hemisphaericus, convexus, conicus vel conico-campanulatus, haud striatus, albus *vel pallido brunneus, totus granuloso-farinosus vel furfuraceus. Margo vestigiis albis veli appendiculato. Lamellae c. 1.5-3.5 mm latae, subdistantae, liberae, primo albidae, denum obscure brunneae, acie albida. Stipes 30-80 x 0.5-1.5 mm (usque ad 2.5 mm in bulbillo), cilindraceo-bulbillosus, cavus, albus, pruinoso-fibrilloso, ad basim vestigiis mycelii albi obtecto. Caro fragilis, albida. Odore saporeque indistictis. Sporae 8.5-11 x 4.5-6 µm, ellipsoideae vel subcilindricae, brunneolae, poro germinativo 2 µm lato. Basidia 15-19 x 8-9 µm, clavata, tetraspora. Cheilocystidia 21-54 x 10-14 µm claviformia vel utriformia, vulgo capitata. Pleurocystidia 28-54 x 13-18 µm, non nula capitata. Pileipellis e cellulis formata. Velum universale ex cellulis catenulati, 14-39 µm diam, globosis vel subglobosi, ubique confertim spinulosa. Hyphae fibulatae.*

Ad terram, inter graminis.

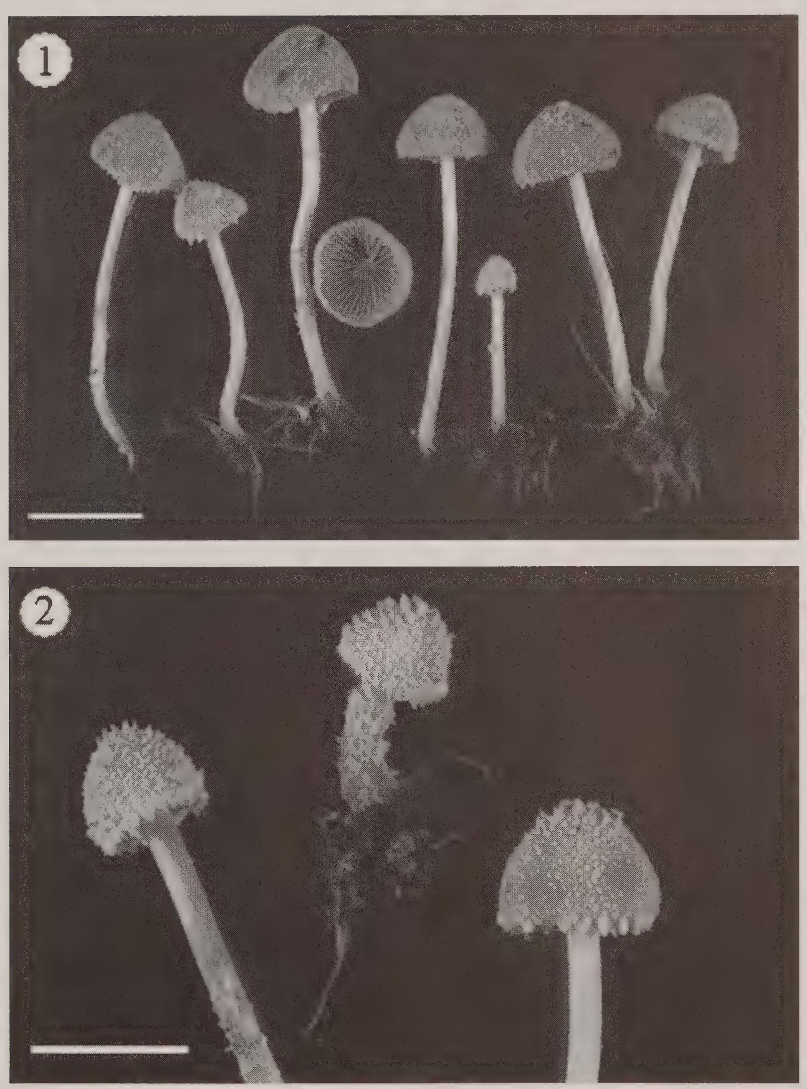
Holotypus: no AH29991

Basidiomata gregarious. Pileus 5-23 mm. in diam., firstly hemisphaerical, later convex to conical or conical-campanulate when mature, finally plano-convex, sometimes with a small central depression, slightly sulcate but not translucently striate, white when young, later very pale brown (10YR 7/3) with pinkish shades (10YR 8/1, 8/2), after loosening of the veil; margin somewhat convolute when young, with abundant fibrillose to floccose whitish veil remains. Universal veil in primordia made up by thick conic to pyramidal white spines, detersile; mature pilei typically lacking spines but covered overall with granular to sacchariferous remains, being easily removed when touched. Lamellae c. 15, free to almost free, up to 3.5 mm broad, convex, crowded, with 1 to 3 lamellulae, white to beige (10YR 7/4) during a long time, finally dark brown (10YR 5/3, 4/3) when mature, edge entirely whitish. Stipe 30-80 x 0.5-1.5 mm, cylindrical to slightly bulbillous at the base (-2.5 mm), hollow, entirely white or whitish, dirty white at the base, totally floccose-fibrillose, specially in young basidiocarps. Context thin, white, taste and smell absent.

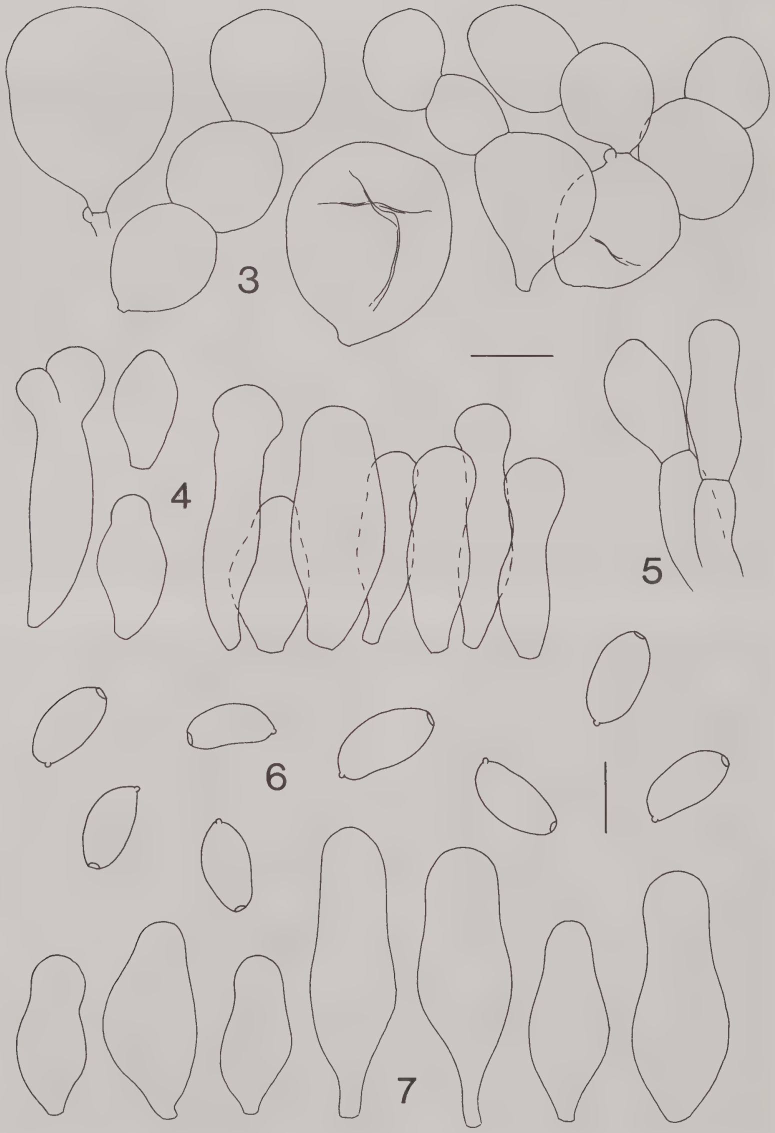
Spores 8.5-*9.5*-10.94(-11) x 4.5-*5.13*-5.86(-6) µm; Q= 1.7-*1.85*-1.95(-2.22); (n= 21), ellipsoid to narrowly ellipsoid, smooth, with a broad central germ pore up to 2 µm. Basidia 15-19 x 8-9 µm, broadly clavate, 4-spored, with short sterigmata 1-1.5 µm. Cheilocystidia 21-54 x 10-14 µm claviform, utriform to narrowly utriform, frequently with subcapitate to capitate apex, capitulum 11-18 µm broad, sometimes with bifurcate. Pleurocystidia 28-54 x 13-18 µm, similar to cheilocystidia, rarely capitate, seldomly capitate. Hymenophoral trama parenchymatous, with broad cells, 17-23 µm in diam. Pileipellis a hymenoderm formed by two layers of subglobose cells, 15-20 µm broad, and some sparse refringent hyphae, up to 5 µm broad. Veil consisting of chains of globose to subglobose hyaline cells, 14-39 µm diam. Stipitipellis formed by parallel, smooth hyphae, 4-6 µm broad, with a mixture of caulocystidia similar to the hymenial cystidia and chains of globose cells from the veil. Clamp connections present at all septa.

Habitat: on manured turf.

Material studied: **Spain**, Madrid. Campus Universidad Autónoma. 7 Oct. 2002, coll. F. Arenal & M. Villarreal, in turf, AH 29991 (Holotype). Ibidem, 12 Oct. 2002, AH 29992, 3 Nov. 2002, AH 29993.



Figs. 1-2. *Psathyrella albofloccosa*. **Fig. 1.** Mature fruitbodies (AH 29991, holotype). **Fig. 2.** Young specimens showing the characteristic pyramidal spinules and floccose veil remains in pileus and stipe (AH 29992). Bars: Fig. 1 = 20 mm; Fig. 2 = 10 mm.



Figs 3-7. *Psathyrella albofloccosa* (AH 29991, holotype). **Fig. 3.** Spherocysts from veil. **Fig. 4.** Cheilocystidia. **Fig. 5.** Caulocystidia. **Fig. 6.** Spores. **Fig. 7.** Pleurocystidia. Bar = 15 µm., except for spores, Bar = 10 µm.

DISCUSSION

None of the monographic contributions on Northern Hemisphere species of *Psathyrella* (SMITH, 1972; KITS VAN WAVEREN, 1985, 1987; FOUCHIER, 1995), or the revision of GRÖGER (1986) of sect. *Cystopsathyra* species, include a taxon similar to the new species proposed. *P. kellermannii* (Peck) Sing. seems to be the closest taxon by the presence of subcapitate utriform cystidia, but differs in the brownish pileus with deeply striate margin, a fugacious veil in patches and the very narrow germ pore (SINGER, 1959). All the other species of *Cystopsathyra* differ by the differently shaped cystidia or, in the case of *P. ornatispora*, by the ornamented spores and absence of cystidia.

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A NEW SPECIES OF CORDANA FROM LITHUANIA

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ABSTRACT

Cordana lithuanica, a new species of dematiaceous hyphomycetous anamorph, collected on decaying wood of *Fraxinus excelsior* and *Picea abies* in forest litter in Lithuania, is described and illustrated. The fungus differs from known species of the genus by the shape and size of the conidia. A key to 13 currently recognized species of the genus *Cordana* is provided.

Key words: *Cordana lithuanica*, taxonomy, key

INTRODUCTION

The genus *Cordana* Preuss was established (Preuss, 1851) for 4 species: *C. pedunculata* Preuss, *C. polyseptata* Preuss, *C. parvispora* Preuss and *C. pauciseptata* Preuss. Saccardo (1886) transferred the first three of these species to the genus *Acrothecium* Preuss, leaving only *C. pauciseptata* in the genus *Cordana.* Hughes (1955) re-examined two type specimens collected by Preuss, and transferred *C. polyseptata* Preuss to the genus *Brachysporium* Sacc., the only remaining species, *C. pauciseptata* Preuss, was accepted as type species of *Cordana.* Several species, which were described in *Cordana* prior to 1983: *C. bambusae* Bat. & Nascim., *C. boothii* M.B. Ellis, *C. oblongispora* Matsush., *C. triseptata* Matsush. and *C. vasiformis* Matsush., have been transferred to other genera or treated as synonyms of other species (Hoog, 1973; Hughes, 1978). In 1981 *C. martini* Sarwar (Sarwar & Parameswaran, 1981) was described from India, however, the description lacked a Latin diagnosis, thus the name was acknowledged as invalid (Vasant Rao & de Hoog 1986). The taxonomic concept of two species: *C. parasitica*

Togashi & Onuma (Togashi & Onuma, 1934) and *C. gilibertiae* Togashi & Katsuki (Katsuki, 1950), described from Japan, remain uncertain. One of them, *C. parasitica*, is accepted in the present key. The type material of *C. parasitica* was lost, but the protologue indicates that the species could be accepted as a species of *Cordana*. Further, nor original publication nor type material of *C. gilibertiae* could be studied, thus the status of this species name is uncertain (Hoog, 1973). The type materials of other invalidly published species, *C. quercina* Arnaud and *C. reticulata* Arnaud (Arnaud, 1954), were not preserved and could not be studied. Kirk (1986) supposed *C. reticulata* to be a synonym of *Ityorhoptrum verruculosum* (M.B. Ellis) P.M. Kirk. Hoog et al., (1983) reviewed the genus *Cordana* and provided an identification key of the genus (including *C. parasitica*) and short descriptions of 8 species, producing two-celled conidia. In the same year two new species were added to the genus: *C. inaequalis* S. Hughes, described from Canada (Hughes, 1983), and *C. abramovii* E. O. Seman & Davydkina, from the Caucasus (Seman, Davydkina, 1983).

For a long time the genus *Cordana* was characterized by brown, intermittently proliferating conidiophores and light brown to dark brown two-celled conidia. However, Vasant Rao & de Hoog (1986) described a new species from India, *C. solitaria* V. Rao & de Hoog, which produced one-celled conidia. The position of this species is still controversial. Matsushima (1975) assumes *C. solitaria* as a synonym of *Arthrobotrys foliicola* Matsush., while other authors (Davydkina & Mel'nik, 1989; Castañeda Ruíz et al., 1999) consider it as a good species. The latter opinion is followed here because, morphologically, *C. solitaria* differs from *Arthrobotrys foliicola* in having non-septate, brown, shorter and wider conidia. Davydkina and Mel'nik (1989) described one more species with one-celled conidia, *C. semaniae* Davydkina, Melnik & Novozh., from the south of Russia.

Recently Castañeda Ruíz et al. (1999) described a new species from Venezuela, *C. miniumbonata* R.F. Castañeda, Iturr. & Guarro, the status of which is very problematic. It is not noted in the description of this species that the fungus produces typical *Cordana* conidiophores (with proliferation and swellings) and, besides, conidia of *C. miniumbonata* differ in their shape and septation mode (2- or 3-septate) from those typical for the genus (0 or 1-septate). This species was not therefore accepted in the present key to the genus. Castañeda et al. (1999) accomodated this fungus in *Cordana* based on the holoblastic conidium ontogeny, denticulate conidiogenous cells and schizolytic conidial secession. However, the same characteristics also fit several other genera, like *Brachysporium*, *Pyriculariopsis* or *Pleurophragmium.* It seems appropriate to transfer this taxon elsewhere, but a new combination is not proposed in this paper.

As presently constituted, the genus *Cordana* includes dematiaceous hyphomycetous anamorphs, characterized by the production of brown to subhyaline, macronematous, mononematous, percurrently proliferating conidiophores, bearing terminal and intercalary conidiogenous swellings. Conidiogenous cells are polyblastic, sympodial with small cylindrical denticles, conidia are light to dark brown, ovoid, obovoid, ellipsoid, pyriform or obpyriform, 0–1-septate, sometimes with a thickened median septum. Conidial secession is schizolytic.

Three species referable to *Cordana* were collected in Lithuania on decaying wood. *C. pauciseptata* is very common on birch wood in various parts of Lithuania.The other species, *C. musae* (Zimm.) Höhn., was found on decaying wood only once in Lithuania, meanwhile it is known as a widespread pathogen on banana leaves (Priest, 1990). Morphological data of two specimens collected on decaying wood of *Fraxinus excelsior* and of *Picea abies* (forest litter, environs of Kėdainiai city) does not agree with any published descriptions and, therefore, a new species is proposed in this paper.

MATERIALS AND METHODS

The material was collected in various forests of Kėdainiai distr., Lithuania. Collections of decaying wood containing fungi were dried and preserved. Descriptions and illustration of the new species ***Cordana lithuanica* sp. nov.** were made from fresh preparations in distilled water and in lactic acid. Specimens are deposited in the Herbaria of the Institute of Botany, Vilnius, Lithuania (BILAS), Komarov Botanical Institute, St. Petersburg, Russia (LE) and CABI Bioscience (IMI).

TAXONOMIC PART

Cordana lithuanica Markovskaja, **sp. nov.** Fig. 1

Etymology: *lithuanica*, referring to the country of collection, Lithuania.

Coloniae effusae, velutinae, brunneae. Mycelium plerumque immersum, ex hyphis ramosis, septatis, subhyalinis vel dilute brunneis compositum. Conidiophora solitaria, macronematica, recta vel subincurvata, simplicia, cylindrica, laevia, pachydermatica 140–170 µm longa, basi 10–12 µm lata, medio 5–6 µm lata, semel ad ter proliferatia, in tumescontibus, terminalibus et intercalaribus ad 9–10 µm crassa praedita, brunnea, vel ad apicem subhyalina, superne pallidiores. Cellulae conidiogenae polyblasticae, terminales, sympodiales, dein intercalares, globosae, ovoideae, unaquauque denticulis 5-7, cylindricis, apice truncatis, leniter eminentibus praeditae. Conidiorum secessio schizolytica. Conidia solitaria, acropleurogena, obpyriforma, transverse uniseptata, pachydermatica, laevia 13–17 × 8–10 µm, brunneae, uniformis vel cellula basalis obscurior quam apicalis, cellula terminalis rotundata, angustior quam basalis.
Teleomorphosis ignota.

Typus: *Lithuania, prope Kėdainiai, Juodkiškiai sylva, 55°14'23"N, 24°1'54"E; in ligno putridino (Fraxinus excelsior), Legit S. Markovskaja, 3.VIII.2000; holotypus in BILAS 21364; isotypus in LE 212424, in IMI 389981.*

Colonies brown, effuse, velutinous. Mycelium mostly immersed, composed of branched, septate, subhyaline to pale brown hyphae. Conidiophores solitary, macronematous, smooth and thick-walled, unbranched, erect or slightly curved, cylindrical, 1–3 times proliferating, up to 140–170 µm long, at the base 10–12 µm wide, at the middle 5–6 µm wide, with terminal and intercalar swellings 9–

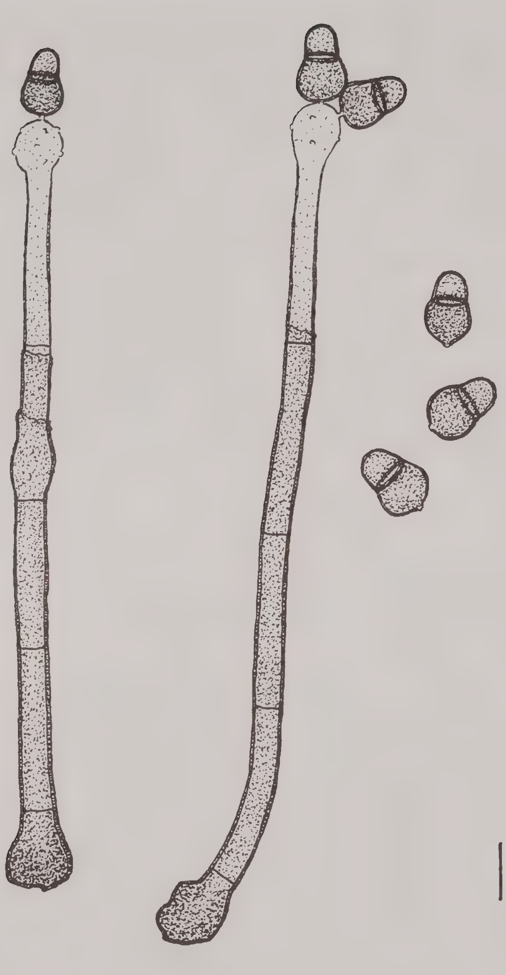

Figure 1. *Cordana lithuanica.* Conidiophores and conidia. Scales = 10 μm

10 μm diam., brown to subhyaline at the apex. Conidiogenous cells polyblastic, terminal, sympodial, later became intercalar swollen or oval with 5–7 slightly protruding plane at the apex cylindrical denticles. Conidial secession schizolytic. Conidia single, acropleurogenous, obpyriform, 1-septate, smooth and thick-walled, both conidial cells are brown, only occasionally basal one is darker, terminal cell with rounded apex and narrower than the basal one, 13–17·5 x 8–10 μm.
Teleomorph unknown.

Other examined material: on decaying wood of *Picea abies*; Lithuania, Kėdainiai distr., Vilainiai forest, 55°18'10"N, 24°1'33"E, Col. S. Markovskaja, 6 June, 2001 (BILAS 21365 – paratype; LE 212425 – isoparatype).

Note: *Cordana lithuanica* is readily distinguished from all other species by conidial morphology: shape, pigmentation and size. It is closest to *C. musae* and *C. crassa.* From *C. musae*, which produce light brown, ovoid to pyriform conidia (11–18 × 7–9 μm), *C. lithuanica* differs in brown, obpyriform conidia (13–17·5 × 8–10 μm); from *C. crassa* it differs mainly in size and pigmentation of conidia. Nevertheless, both *C. lithuanica* and *C. crassa* have obpyriform and consistently narrower terminal conidial cell if compared to the basal one, but the terminal cell of *C. crassa* is light brown with an acute apex and the basal cell is dark brown (18·5–27 × 9·5–15 μm), while *C. lithuanica* produces uniform, brown pigmented and smaller conidia with a rounded apex.

Key to currently accepted species of genus *Cordana* Preuss

1a Conidia 0-septate 2
1b Conidia 1-septate 3

2a Conidia obovoid, at first hyaline, later becoming black, with acute basal cell, 21–27 × 9–15 μm .... C. *semaniae*
2b Conidia obovoid to broadly ellipsoidal, pale brown, slightly papillate at the base with hyaline protruding scar, 6·5–9·5 × 4·5–6·5 μm .... *C. solitaria*

3a Conidial septum markedly thickened, brownish-black, conidia oblong, ellipsoid to ovoid 4
3b Conidial septum not differentiated, conidia ovoid to pyriform or obpyriform 6

4a Conidia with acute apex, ellipsoid, brown to dark brown .... *C. pauciseptata*
4b Conidia with rounded apex, oblong, ellipsoid to ovoid, brown 5

5a Conidia oblong to broadly ellipsoid, both cells more or less equal and uniformly pigmented, pale brown to brown .... *C. ellipsoidea*
5b Conidia ellipsoid to ovoid, the basal cell brown and obviously larger than the distal cell .... *C. inaequalis*

6a Conidia obpyriform, terminal cell consistently narrower than the basal cell 7
6b Conidia ovoid to pyriform, terminal cell usually wider than the basal cell 8
6c Conidia ellipsoid, both cells of nearly equal width 9

7a Basal cell dark brown, terminal cell light brown with an acute apex; 18·5–27 × 9·5–15 µm .... *C. crassa*
7b Both cells brown, terminal cell with rounded apex; 13–17·5 × 8–10 µm .... ***C. lithuanica***

8a Conidia ovoid to pyriform, light brown, 11–18 × 7–9 µm .... *C. musae*
8b Conidia ovoid, at first light brown, later becoming dark brown, with pigmented septal pore; 18–31 × 12·5–15·5 µm ... *C. abramovii*

9a Conidia broadly ellipsoid to subglobose, >10 µm wide 10
9b Conidia ellipsoidal to obovoid, <10 µm wide 11

10a Conidia 20–30 × 12–18 µm .... *C. johnstonii*
10b Conidia 17–19 × 10–13 µm .... *C. andinopatagonica*

11a Conidia elongate, 11–20 × 4·5–7 µm .... *C. indica*
11b Conidia oblong, 6–10 × 3–5 µm .... *C. parasitica*

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CARIBBEAN HETEROBASIDIOMYCETES: 1. DOMINICAN REPUBLIC

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Abstract. 32 species of heterobasidiomycetous fungi belonging to the orders Atractiellales, Auriculariales, Ceratobasidiales, Dacrymycetales, Exidiales, Septobasidiales, Tremellales, and Tulasnellales are described or reported from the Dominican Republic. *Ductifera bistrata* is described as new. *Ductifera elastica* is synonymized with *Exidiopsis galzinii*.

Keywords. Atractiellales, Auriculariales, Ceratobasidiales, Dacrymycetales, Exidiales, Septobasidiales, Tremellales, Tulasnellales

The majority of species recorded in this paper were collected by the author in 1997 as part of the USA National Science Foundation, Biotic Surveys and Inventories Program for the Greater Antilles. Additional material was collected by other participants in the programme.

The sites surveyed included: 1) the Reserva Científica Ebano Verde in La Vega province, an upland area of degraded and secondary deciduous woodland, with a small area of cloud forest, dry at the time of visit; 2) the Valle Nuevo, also in La Vega province, an upland area of degraded native and secondary pine forest, quite productive of conifer species, particularly among the Dacrymycetales; and 3) Parque del Este in La Altagracia province, an area of xerophytic coastal scrub and woodland, extremely dry at the time of visit.

Previous collections from the Dominican Republic held in the herbarium of the Royal Botanic Gardens, Kew, are also recorded here. These include unlocalized specimens collected by the naturalist Augusto Sallé, who travelled widely in the Dominican Republic during the years 1849-1851 (Jiminez, 1985). His material was examined and published by Berkeley (1852).

References to Dominican Republic heterobasidiomycetes in other publications have also been noted. The main sources have been the comprehensive checklist of the country's fungi by Ciferri (1961), the booklet on neotropical heterobasidiomycetes by Lowy (1971), and the checklist of Caribbean fungi by Minter *et al*. (2001).

ATRACTIELLALES

Helicobasidium purpureum *Pat.* in Bull. Soc. Bot. France 32: 172 (1885)
[anamorph] *Thanatophytum crocorum* (Pers.) Nees, Syst. Pilze: 148 (1816)
Rhizoctonia violacea Tul. & C. Tul., Fungi Hypog.: 188 (1862)

SPECIMEN EXAMINED: **DOMINICAN REPUBLIC**: Espaillat, Valle del Cibao, Moca, Est. Nac. Agronómica, on *Asparagus officinalis*, Jul. 1928, *R. Ciferri* (Myc. Doming. Exs. 406, as *Rhizoctonia violacea*), **K(M) 51769**.

This auricularioid species, illustrated in Roberts (1999a), has a rhizoctonia state (*Thanatophytum crocorum*) with unclamped, purplish hyphae and occasional sclerotia. It is a well-known crop pathogen causing 'violet root rot' and other diseases, and hence is usually collected from horticultural and agricultural sites. The specimen on *Asparagus*, cited above, is just such a collection, sterile and in the rhizoctonia state. The species was additionally reported from the Dominican Republic by Ciferri (1961) on *Medicago sativa*.

Hobsonia mirabilis *(Peck) Linder* in Ann. Missouri Bot. Gard. 16: 340 (1929)

Fruitbodies viscid-gelatinous, soft and deliquescent, pulvinate, 10 – 30 mm diam., smooth, coalescing, hyaline to opalescent whitish. *Hyphae* in a loose gelatinous matrix, 2 – 4.5 μm wide, hyaline, thin-walled, lacking clamp-connexions. *Coiled propagules* arising on short side-branches from hyphae, the individual coils hypha-like, hyaline with granular contents, 10 – 15 μm wide, thick-walled, multi-septate, variously spiralling several times to form a propagule some 50 – 80 μm wide. *Spores* not known.

SPECIMENS EXAMINED: **DOMINICAN REPUBLIC**: La Vega, Reserva Científica Ebano Verde, Loma la Sal, riverside, on decorticated stick, 30 May 1997, *S. Cantrell* (*Roberts* GA73), **K(M) 86271**; Reserva Científica Ebano Verde, near Field Station, on fallen wood, 30 May 1997, *J. Carranza* (*Roberts* GA75), **K(M) 97244**; same date and location, on dead palm stem, *L. Ryvarden* (*Roberts* GA76), **K(M) 55749**.

Hobsonia mirabilis produces viscid-gelatinous, hyaline to whitish fruitbodies on a variety of woody or herbaceous substrata, particularly old, decaying palm fronds. It has long been classed as an anamorphic ascomycete, but recent molecular research (Sikaroodi *et al.*, 2001) has suggested that *Hobsonia* is related to the genus *Helicogloea* in the Atractiellales. A specimen from Venezuela was illustrated in Roberts (2003).

AURICULARIALES

Auricularia cornea *Ehrenb.*, in Nees von Esenbeck, Horae Phys. Berol.: 91 (1820)
Exidia hispidula Berk. in Ann. Nat. Hist. II, 3: 396 (1839)
Auricularia polytricha (Mont.) Sacc. in Atti. R. Inst. Veneto VI. 3: 722 (1885) *fide* Wong & Wells (1987)

SPECIMENS EXAMINED: **DOMINICAN REPUBLIC**: unlocalized, ca. 1850, *Sallé*, as *Exidia auricula-judae*, **K(M) 61979**; same details, as *Exidia hispidula*, **K(M) 60073**; same details, (ex herb. M.C. Cooke), **K(M) 60072**; unlocalized, ca. 1850, *Sallé* 63 (ex herb. C.E. Broome), as *Exidia hispidula*, **K(M) 60074**; same details, (ex herb. M.J. Berkeley), **K(M) 60146**; unlocalized, ca. 1850, *Sallé* 79 (ex herb. M.C. Cooke), as *Exidia hispidula*, **K(M) 60071**; same details, (ex herb. C.E. Broome), as *Exidia auricula-judae*, **K(M) 61980**; same details, (ex herb. M.J. Berkeley), **K(M) 61981**; La Altagracia, Bayahibe, on rotting mangrove twigs, 2 June 1997, *N.W. Legon*,

K(M) 54645; La Altagracia, Río Chavón, La Reserva, on twig, 4 June 1997, *Roberts* GA169, **K(M) 85970**.

Auricularia cornea is a common and conspicuous pantropical species, distinguished from similar taxa by its smooth hymenium and hirsute, but unzoned pileus. The species was originally recorded from the Dominican Republic by Berkeley (1852) under the name *Exidia hispidula*. It has additionally been reported from the provinces of La Vega and San Pedro de Macoris in Minter (2001).

Auricularia delicata *(Fr.) Henn.* in Bresadola, Hennings, & Magnus, Bot. Jahrb. Syst. 17: 492 (1893)
Laschia tremellosa Fr., Summa Veg. Scand.: 325 (1849)

Specimens Examined: **Dominican Republic**: unlocalized, ca. 1850, *Sallé*, as *Laschia delicata*, **K(M) 56018**; unlocalized, ca. 1850, *Sallé* 64, as *Laschia tremellosa*, **K(M) 51810**; same details (ex herb. C.E. Broome), as *Laschia delicata*, **K(M) 56084**.

Auricularia delicata is a common pantropical species characterized by its distinctly reticulate hymenium. The species was originally recorded from the Dominican Republic by Berkeley (1852) under the name *Laschia delicata*. It was additionally reported from the province of La Vega by Lowy (1971) and from the provinces of Hato Major, La Altagracia, and San Pedro de Macoris in Minter (2001).

Auricularia fuscosuccinea *(Mont.) Henn.*, Bot. Jahrb. Syst. 17: 19 (1893)

Auricularia fuscosuccinea is a common neotropical species, distinguished by its smooth, purplish brown basidiomes, without a macroscopically hirsute pileus. It was reported from La Altagracia and La Vega provinces by Minter (2001).

CERATOBASIDIALES

Thanatephorus cucumeris *(A.B. Frank) Donk* in Reinwardtia 3: 376 (1956)
[anamorph] *Rhizoctonia solani* J.G. Kühn, Die Krankheiten der Kulturgewächse: 224 (1858)

Rhizoctonia solani, the anamorphic (mycelial) state of *Thanatephorus cucumeris*, is a cosmopolitan plant pathogen on an extremely wide range of hosts. It was reported by Ciferri (1961) on cf. *Gossypium* sp., cf. *Medicago sativa*, and *Phaseolus vulgaris*, with a note saying that the perfect state had never been found in the Dominican Republic. The species was described and synonyms listed in Roberts (1999a).

DACRYMYCETALES

Dacrymyces minor *Peck* in Rep. New York Mus. Nat. Hist. 30: 49 (1878)

Basidiomes gelatinous, pale yellow, around 0.5 - 2 mm diam., irregularly discoid, gregarious, coalescing. *Hyphae* in a weakly gelatinized context, 1.5 - 4 µm wide, with thin to distinctly gelatinized walls sometimes with granular encrustations, lacking clamp-connexions. *Basidia* ca. 35 - 45 µm long (ex. sterigmata). *Hyphidia* simple. *Basidiospores* cylindrical (Q = 2.2 - 3.0), ca. 10 - 13 (- 16) x 4.5 - 6 µm, often ventrally depressed, becoming 1 - 3-septate when mature, the septa thin to slightly thickened.

Specimens Examined: **Dominican Republic**: La Vega, Valle Nuevo, on dead attached *Pinus* branch, 31 May 1997, *Roberts* GA88, **K(M) 98258**; same location, on twig of shrub, 1 June 1997, *Roberts* GA136, **K(M) 86295**.

These collections fall within the rather featureless group of unclamped *Dacrymyces* species with 1-3-septate basidiospores. The basidiomes are small, gregarious, and irregularly discoid; the basidiospore septa are thin (in K(M) 98258) to slightly thickened (in K(M) 86295). There are other slight differences between the two collections, including substrata, but following McNabb (1973), both seem best referred to *Dacrymyces minor*. This is a cosmopolitan species originally described from North America and very probably a complex of closely related taxa.

Some basidiomes in the collection K(M) 86295 were parasitized by the auricularioid species, *Occultifur internus* (Platygloeales, see below).

Dacrymyces minutus *(L.S. Olive) McNabb* in New Zealand J. Bot. 11: 497 (1973) **Fig. 1**

Basidiomes gelatinous, orange-yellow, around 3 mm diam., irregularly discoid. *Hyphae* in a weakly gelatinized context, narrow, 1 - 2.5 µm wide, thin-walled, with clamp-connexions; abhymenial hyphae highly gelatinized in the outer one or two compartments, the terminal compartment clavate, around 9 - 12 µm wide. *Basidia* ca. 40 µm long (ex. sterigmata). *Hyphidia* simple. *Basidiospores* cylindrical (Q = 2.9 - 3.0), 16 - 18 x 5.5 - 6 µm, often ventrally depressed, becoming 1 - 3-septate when mature, the septa thin.

SPECIMEN EXAMINED: **DOMINICAN REPUBLIC**: La Vega, Valle Nuevo, on dead attached *Pinus* twig, 31 May 1997, *Roberts* GA80, **K(M) 97281**.

Following McNabb (1973), this small species is well characterized by having clamp-connexions, swollen terminal hyphae on the abhymenial surfaces, and 1 - 3-septate basidiospores with narrow septa. It was originally described on pine from the southern United States.

Dacrymyces stillatus *Nees*, Syst. Pilze Schwam.: 89 (1816)

Basidiomes gelatinous, amber, up to 1 mm diam., pustular, gregarious. *Hyphae* 2 - 4 µm wide, mostly thin-walled, in a weakly gelatinized context, lacking clamp-connexions. *Basidia* ca. 40 µm long (ex. sterigmata). *Hyphidia* inconspicuous, cylindrical. *Basidiospores* oblong to cylindrical (Q = 1.9 - 2.3), 14 - 15 x 6 - 7 µm, often ventrally depressed, thick-walled, 1 - 3-septate when mature, the septa very thick.

SPECIMENS EXAMINED: **DOMINICAN REPUBLIC**: La Vega, Valle Nuevo, on thin, decorticated branches, 1 June 1997, *S. Cantrell* (*Roberts* GA138), **K(M) 86270**; same location and date, on dead attached *Pinus* twigs, 1 June 1997, *S. Cantrell* (*Roberts* GA320), **K(M) 98259**.

These are two further collections falling within the group of unclamped *Dacrymyces* species with 1 - 3-septate basidiospores. Following McNabb (1973), the specimens are provisionally assigned to the cosmopolitan species-complex of *D. stillatus* because of their distinctly thick-walled basidiospores, but the basidiomes are unusually small and there is no trace of an anamorphic state. *Dacrymyces intermedius* L.S. Olive, described from Tahiti, is similar in having small basidiomes and thick-walled basidiospores, but is also said to have thick-walled terminal hyphal ends on the abhymenial surfaces which are lacking in the Dominican Republic collections.

Dacrymyces variisporus *McNabb* in New Zealand J. Bot. 11: 504 (1973)

Basidiomes gelatinous, pale yellow, up to 3 mm diam., irregularly discoid to turbinate. *Hyphae* thin-walled, in a weakly gelatinized context, with clamp-connexions. *Basidia* up to 65 µm long (ex. sterigmata). *Hyphidia* simple, septate and clamped. *Basidiospores* (few seen) up to 22 x 9 µm, 3 - 7-septate when mature, the septa thin.

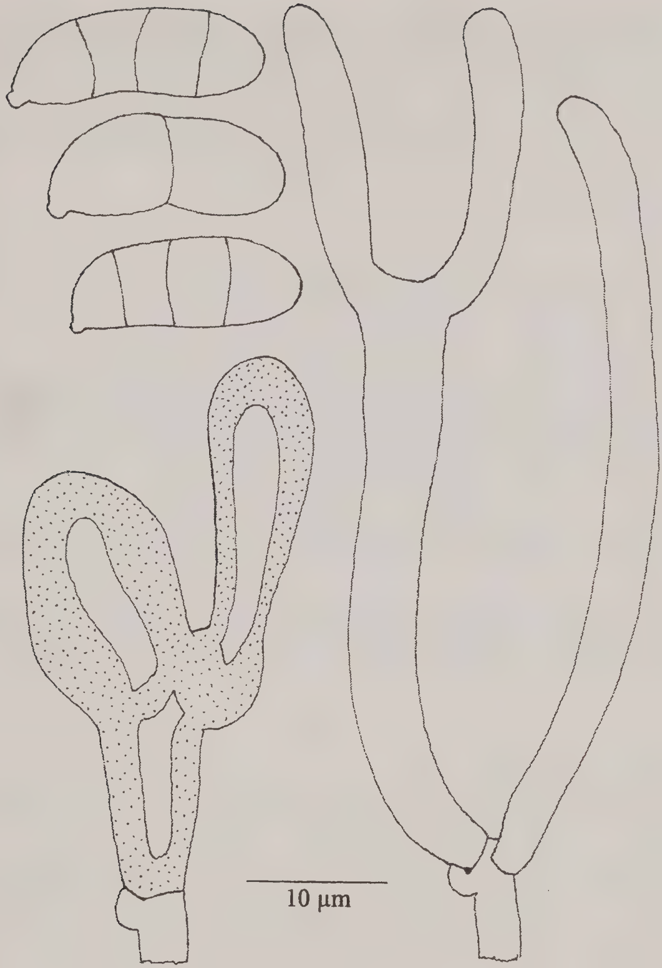

Fig. 1. **Dacrymyces minutus.** Basidiospores, thick-walled, gelatinized, terminal hyphae in abhymenium; basidia and simple hyphidium (Roberts GA80).

Specimens Examined: **Dominican Republic**: La Vega, Valle Nuevo, on dead standing *Pinus* twigs, 1 June 1997, *S. Cantrell* (*Roberts* GA139), **K(M) 86266**; same details, *S. Cantrell* (*Roberts* GA137), **K(M) 86269**; **USA**: Washington, Klickitat County, Falcon Valley, on stump of *Pinus ponderosa*, 25 Sept. 1894, *W.N. Suksdorf* 475, holotype, **K(M) 84438**.

The Dominican Republic material compares well with the North American type collection (cited above) in its pine substratum, comparatively small discoid to turbinate basidiomes, thin-walled hyphae with clamp-connexions, and large, 3 - 7-septate basidiospores.

Dacryopinax elegans *(Berk. & M.A. Curtis) G.W. Martin* in Lloydia 11: 116 (1948)

This is a species with 3-septate basidiospores, originally described from the southern United States and reported by Lowy (1971) for La Vega province.

Dacryopinax spathularia *(Schwein.) G.W. Martin* in Lloydia 11: 116 (1948)

This is a ubiquitous tropical species with single-septate basidiospores, reported in Minter (2001) for La Vega province. A collection macroscopically resembling *Dacryopinax spathularia* was made by the present author in Valle Nuevo, but the single basidiome was sterile and not retained.

Guepiniopsis buccina *(Pers.) L.L. Kenn.* in Mycologia 50: 888 (1958)

Specimens Examined: **Dominican Republic**: La Vega, Valle Nuevo, on dead attached twigs of shrub, 1 June 1997, *Roberts* GA79, **K(M) 86278**; same details, *S. Cantrell* (*Roberts* GA129), **K(M) 107563**.

Guepiniopsis buccina is a cosmopolitan species having discoid or cup-shaped basidiomes with an elongated stipe (hence the epithet 'buccina' = trumpet). The hyphae lack clamp-connexions and there are no distinctive abhymenial hairs.

EXIDIALES

Basidiodendron excentrispora *P. Roberts* in Kew Bull. 56: 168 (2001)

Specimen Examined: **Dominican Republic**: La Vega, Reserva Científica EbanoVerde, Cassavitas, on rotten wood, 29 May 1997, *Roberts* GA24, **K(M) 55688**.

Basidiodendron excentrispora, described and illustrated in Roberts (2001), is distinguished from similar taxa by its subglobose to ellipsoid basidiospores (ca. 4 - 6 x 3 - 4 µm) with a conspicuous, excentric apiculus. The species appears to be widespread in Africa and the neotropics.

Ductifera bistrata *P. Roberts* **sp. nov.** **Fig. 2**

Basidiomata gelatinosa, hyalina. *Hyphae* 1.5 - 2 µm latae, fibulatae; hymenium stratum distinctum formans. *Hyphidia* ramosa vel nodulosa. *Gloeocystidia* abundantia, tubularia, usque ad 50 µm longa, flava vel fulva. *Basidia* bicellularia vel quadricellularia, ellipsoidea, usque ad 27 x 21 µm. *Sterigmata* sinuosa. *Basidiosporae* oblongae, 13.5 - 18 x 7.5 - 9.5 µm.

Basidiomes gelatinous, hyaline, possibly subfoliaceous, drying to a yellowish film with a distinct brownish surface layer. *Hyphae* not agglutinated, in an open, gelatinous matrix, narrow, 1.5 - 2 µm wide, hyaline, with clamp-connexions (often open) and frequent connectives, the hymenium arising as a distinct layer from the context hyphae. *Hyphidia* narrow, 1 - 1.5 µm wide, branched, nodulose or irregular. *Gloeocystidia* abundant and conspicuous in the hymenium, tubular, up to 50 µm long, not projecting above the hymenium, filled with yellow to tawny, highly refractive, cyanophilous, oily contents. *Basidia* 2 - 4 celled, vertically septate, very large, ellipsoid, up to 27 x 21 µm. *Sterigmata* 2 - 4, elongated and sinuous. *Basidiospores* oblong (Q = 1.6 - 1.9), some ventrally depressed, 12.5 - 18 x 7.5 - 9.5 µm, smooth.

SPECIMEN EXAMINED: **DOMINICAN REPUBLIC**: La Vega, road to Valle Nuevo, on deciduous wood, 1 June 1997, *S. Cantrell* (*Roberts* GA147), holotype, **K(M) 99811**.

Ductifera bistrata is distinguished by its hyaline colour when fresh, by the marked stratification (when dry) between a wide gelatinous context and darker surface hymenium, by its abundant yellow-brown gloeocystidia, by its large basidia arising from narrow hyphae, and by its comparatively wide, non-allantoid basidiospores. Field notes are brief, but the specimen was thought to be an *Exidia* species when collected and subsequently dried to a gelatinous film, in the manner of many simple, foliaceous species.

Very few *Ductifera* species have basidiospores comparable in size to the collection cited here. In the monographic treatment by Wells (1958), only the South African *D. micropera* (Kalchbr. & Cooke) K. Wells has spores of similar length, but they are allantoid and narrower (15 - 21 x 5.5 - 7.5 µm *fide* Wells; Q = ca. 2.7). Re-examination of the type collection confirms this and also shows that the basidiomes are small and erumpent, drying brown, the basidia are substantially smaller, the gloeocystidia infrequent and mostly hyaline, and the context far less gelatinized.

Following Wells' monograph, Lowy described several additional neotropical species (Lowy, 1971; 1980), of which *Ductifera exidioidea* Lowy and *D. calcarea* Lowy are large-spored. The former, however, has a 'dark cinnamon-brown' basidiome and narrow, allantoid basidiospores (15 - 18 x 4.5 - 5.5 µm; Q = ca. 3.3). The latter is 'greyish-white', contains conspicuous calcareous nodules, and also has narrow basidiospores (14 - 18.5 x 6 - 7 µm; Q = ca. 2.3 - 2.6), as well as smaller basidia.

Exidia glandulosa *(Bull.) Fr.*, Systema Mycol. 2: 224 (1822)

SPECIMEN EXAMINED: **DOMINICAN REPUBLIC**: La Vega, Valle Nuevo, on dead attached twig, 1 June 1997, *L. Ryvarden* (*Roberts* GA96), **K(M) 97029**.

Exidia glandulosa is a cosmopolitan species, having dark brown turbinate to discoid basidiomes, the hymenium dotted with sterile hyphal pegs. The specimen cited above appears conspecific with European material.

Exidiopsis galzinii *(Bres.) Killerm.* in Engler & Prantl, Die natürlichen Planzenfamilien (2nd ed.) 6: 113 (1928) **Fig. 3**
Sebacina galzinii Bres. in Ann. Mycol. 6: 46 (1908).
Bourdotia galzinii (Bres.) Bres. & Torrend in Broteria Sér. Bot. 11: 88 (1913).
Bourdotia caesia Bres. & Torrend in Broteria Sér. Bot. 11: 88 (1913).
Sebacina petiolata D.P. Rogers in Pacif. Sci. 1: 99 (1947).
Bourdotia petiolata (D.P. Rogers) K. Wells in Lloydia 20: 54 (1957).
Myxarium galzinii (Bres.) Wojewoda, Mała Flora Grzybów II: 55 (1981).
Ductifera elastica Lowy in Mycotaxon 15: 97 (1982).

Basidiomes effused, without distinct borders, smooth, ceraceous to subgelatinous, bluish-grey, drying to a mucous film. *Hyphae* not agglutinated, in an open, gelatinous matrix, hyaline, with clamp-connexions, the hymenium arising from a wide layer of subhymenial or context hyphae. *Hyphidia* branched, forming an extensive layer above the basidia. *Cystidia* abundant and conspicuous, tubular, up to 70 µm long, not or barely projecting above the hymenium, filled with yellow to tawny, highly refractive, cyanophilous, oily contents. *Basidia* 2 - 4 celled, vertically septate, ellipsoid, 16 - 20 x 9 - 11 µm, with a distinct stalk which becomes enucleate (myxarioid) at maturity. *Sterigmata* 2 - 4, elongated and sinuous. *Basidiospores* oblong (Q = 1.4 - 1.7), 9.5 - 11 x 6 - 7.5 µm, smooth.

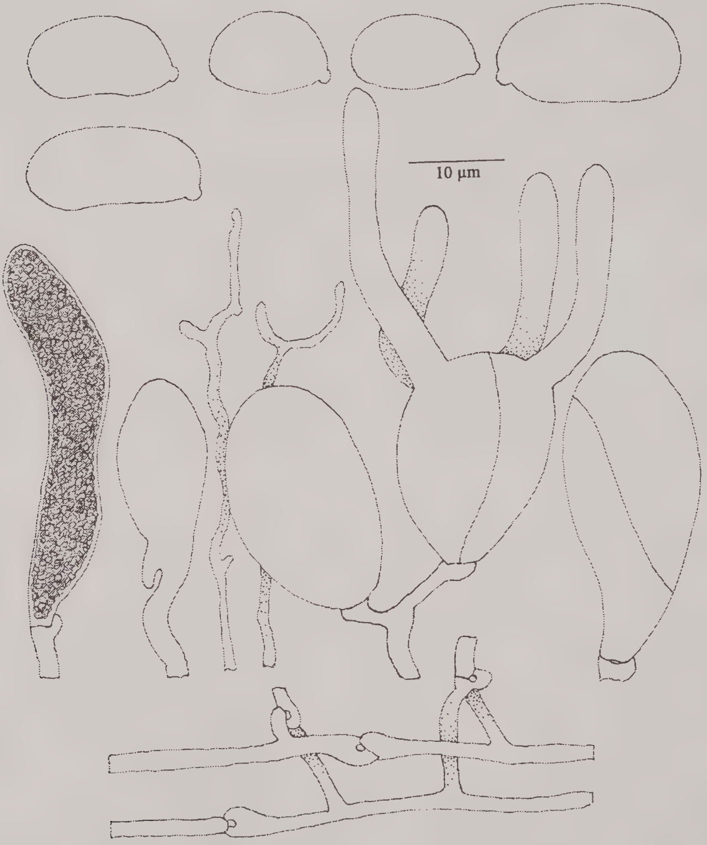

Fig. 2. **Ductifera bistrata**. Basidiospores; gloeocystidium, branched hyphidia, and basidia; clamped hyphae.

Specimens Examined: **Brazil**: Acre, N. of Rio Branco on road to Porto Acre, on rotten wood, 11 Oct. 1980, *B. Lowy* BR 646, (holotype of *Ductifera elastica*) **LSUM**; **Dominican Republic**: La Altagracia, Parque del Este, on fallen wood, 3 June 1997, *Roberts* GA149, **K(M) 96842**; **France**: Aveyron, St Sernin, on *Fraxinus*, May 1905, *A. Galzin* 3832, (holotype) S; **Marshall Islands**: Likiep Island, on trunk of *Cocos nucifera*, 28 Aug. 1946, *D.P. Rogers* 1475, (isotype of *Sebacina petiolata*) **K(M) 48795**; **Portugal**: unlocalized, on wood, 1905, *C. Torrend*, (isotype of *Bourdotia caesia*) **K(M) 47393**.

Exidiopsis galzinii is distinguished by its effused, ceraceous-gelatinous basidiomes, its abundant enclosed gloeocystidia, layer of branched hyphidia, and myxarioid (stalked) basidia. The species is cosmopolitan, and the specimen from the Dominican Republic appears conspecific with the French type collection (cited above).

The type of *Bourdotia petiolata* (cited above) also has myxarioid basidia and similar spores. Wells (1957) differentiated the species on 'basidial characters, spore shape and size, and the more finely branched dikaryophyses', but later (Wells & Raitviir 1975) considered *B. petiolata* a synonym of *E. galzinii*, a view accepted here. The type of *Bourdotia caesia* (cited above) has myxarioid basidia and basidiospores measuring 8.5 - 11 x 5 - 6 µm. It appears conspecific with *E. galzinii*, as already noted by Wells (1959). The type of *Ductifera elastica* (also cited above) has myxarioid basidia and basidiospores measuring 8 - 10.5 x 5 - 5.5 µm and appears to be a further synonym, though not previously reported as such.

Heterochaete shearii (*Burt*) *Burt* in Ann. Missouri Bot. Gard. 8: 377 (1921)

Specimens Examined: **Dominican Republic**: La Altagracia, Río Chavón, La Reserva, on stick, 4 June 1997, *Roberts* GA166, **K(M) 85967**; same details, *Roberts* GA168, **K(M) 97238**.

Heterochaete shearii can be distinguished macroscopically by its effused, greyish-brown basidiomes, bruising brown, with abundant but irregular, tubular hyphal pegs, and microscopically by its brown subicular hyphae, abundant cystidia-like elements in the hymenium, and consistently bisterigmate basidia (illustrated in Roberts, 2001). The species has been widely recorded in the Caribbean (Minter 2001), Central, and South America, Africa, Asia, and southern Europe.

Phyllogloea singeri *Lowy* in Mycologia 51: 840 (1961)

This is a foliaceous, *Tremella*-like species with auricularioid basidia, reported by Minter (2001) for La Vega province.

Stypella glaira *(Lloyd) P. Roberts* in Mycotaxon 69: 219 (1998)

Specimen Examined: **Dominican Republic**: La Vega, Valle Nuevo, on *Pinus* log, 1 June 1997, *Roberts* GA119, **K(M) 55750**.

This species, described and illustrated in Roberts (1998), has multiple, small, gelatinous basidiomes which coalesce to form an effused, compound fruitbody. It is distinguished from other *Stypella* species by its subglobose basidiospores and lack of cystidia.

Tremellodendron simplex *Burt* in Ann. Missouri Bot. Gard. 2: 740 (1915)

This is a clavarioid species with tremelloid basidia, reported by Ciferri (1961) for La Vega province.

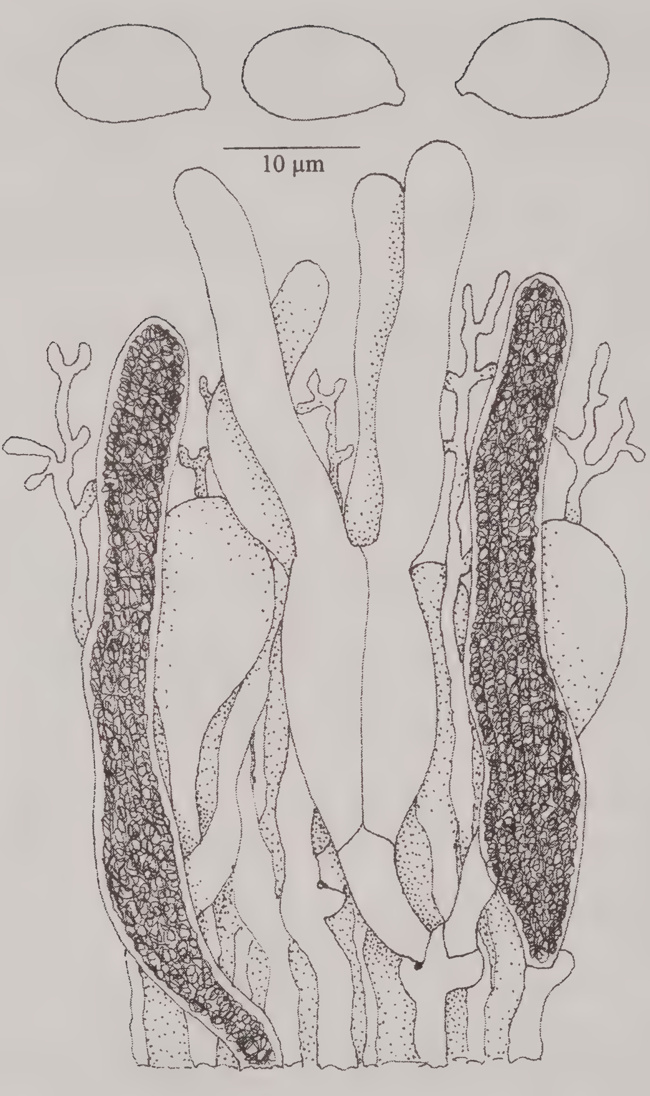

Fig. 3. **Exidiopsis galzinii**. Basidiospores; section of hymenium showing gloeocystidia, branched hyphidia, and myxarioid basidium.

Tremellostereum dichroum *(Lloyd) Ryvarden* in Mycotaxon 27: 323 (1986)

This is a *Stereum*-like species with bisterigmate, tremelloid basidia, reported in Minter (2001) for La Altagracia province.

PLATYGLOEALES

Occultifur internus (L.S. Olive) Oberw. in *Rep. Tottori Inst.* 28: 120 (1990) **Fig. 4**

Basidiomes not macroscopically visible, hyphae and basidia occurring within the host hymenium. *Hyphae* narrow, 1.5 - 3 µm wide, hyaline, thin-walled, with clamp-connexions. *Haustorial cells* swollen, ellipsoid to oblong, giving rise to thin, tendril-like outgrowths. *Conidiophores* clavate, 7 - 10 x 2.5 - 4 µm, arising singly or in clusters, apically budding off conidia from separate clamp-connexions, leaving the remains of each clamp behind. *Conidia* ellipsoid to cylindrical, 5 - 8.5 x 3 - 4.5 µm, with thickened, gelatinized walls. *Basidia* auricularioid, triseptate, thin-walled, short-stalked, 20 - 35 x 3.5 - 4 µm. *Sterigmata* sinuous. *Basidiospores* (few seen) ovoid to ellipsoid (Q = 1.4), 3.5 - 7 x 2.5 - 5 µm, germinating by germ tube or yeast cells.

SPECIMEN EXAMINED: DOMINICAN REPUBLIC: La Vega, Valle Nuevo, in basidiomes of *Dacrymyces minor* (*Roberts* GA136 - see above) on deciduous twig, 1 June 1997, *Roberts* GA324, **K(M) 86296**.

Occultifur internus is an auricularioid parasite of *Dacrymyces* basidiomes, growing inside the hymenium. The species was originally described from North America and is widespread in Europe, though seldom collected. The Dominican Republic collection is scant but appears conspecific with the type, possessing clamp-connexions, haustorial cells, and distinctive conidiophores, though the dimensions of all elements are slightly smaller than is typical in European collections.

SEPTOBASIDIALES

Septobasidium griseum *Couch*, The genus *Septobasidium*: 98 (1938)

Couch (1938) noted a specimen of this species from the Dominican Republic, collected on scale insects on the trunk of *Citrus sinensis*. The collection had originally been determined as *S. lilacinum* Burt, which probably accounts for the listing of this latter species in Ciferri (1961).

Septobasidium spongium *(Berk. & M.A. Curtis) Pat.*, Essai Taxon.: 10 (1900)

SPECIMEN EXAMINED: **DOMINICAN REPUBLIC**: Espaillat, Valle del Cibao, Moca, Est. Nac. Agronóm., on leaves of *Citrus sinensis*, undated, *R. Ciferri* (Myc. Doming. Exs. 293), **K(M) 96756**.

The specimen above was sent out under the name *Septobasidium spongium*. Comparison with the Cuban type specimen (*C. Wright* 566, K(M) 107706) suggests that the two collections are certainly similar, both having prominent subglobose probasidia. The type, however, is on bark rather than leaves.

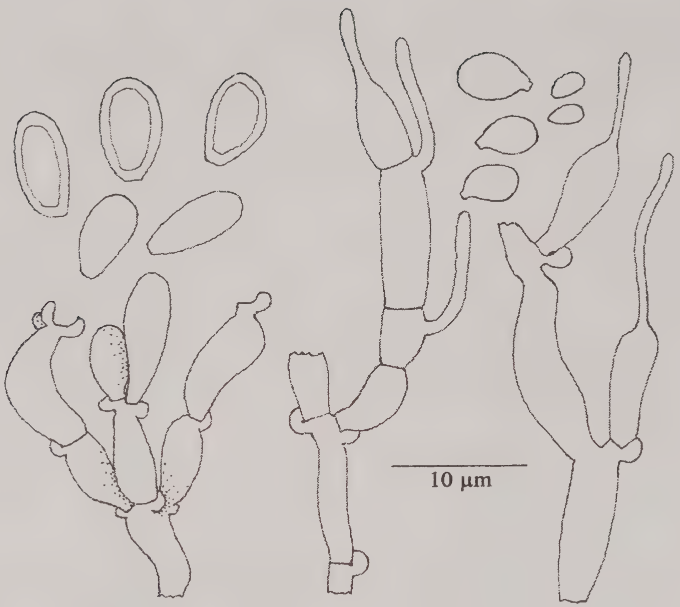

Fig. 4. **Occultifur internus**. Conidiospores, some thick-walled, and conidiophores; auricularioid basidium, basidiospores and yeast cells, hypha with haustorial cells.

TREMELLALES

Tremella foliacea *Pers*., Obs. Mycol. 2: 98 (1799)
Tremella fimbriata Pers., Obs. Mycol. 2: 97 (1799)

Specimen Examined: **Dominican Republic**: La Vega, Valle Nuevo, on dead attached twigs of shrub, 1 June 1997, *Roberts* GA127, **K(M) 96859**.

Tremella foliacea is a cosmopolitan species with brown, foliaceous basidiomes, previously reported from the Dominican Republic by Ciferri (1961). Specimens from England were described and illustrated in Roberts (1999b) and from Brazil in Roberts & de Meijer (1997). It is normally assocated with the mycelia of *Stereum* species, though no basidiomes of the latter were seen in the collection cited above.

Tremella harrisii *Diederich* in Biblio. Lichenologica 61: 85 (1996)

Tremella harrisii produces small, waxy basidiomes on thalli of lichenized ascomycetes in the family Trypetheliaceae. A specimen from San Cristobal on *Trypethelium ochroleucum* was noted by Diederich (1996), who also described and illustrated the species.

Tremella cf. **indecorata**, *Sommerf.*, Suppl. Fl. Lappland: 306 (1826)

Basidiomes gelatinous, pustular, erumpent, ca. 2 - 3 mm diam., hyaline-opalescent, whitish, not visible on drying. *Hyphae* in an open, gelatinous matrix, 1.5 - 6.5 µm wide, hyaline, with clamp-connexions. *Conidiophores* not seen. *Conidia* not seen. *Basidia* 4-celled, mostly diagonally septate, ellipsoid (more rarely narrowed and oblong), 12 - 20 x 10 - 14 µm, unstalked or with a distinct stalk up to 10 µm long. *Sterigmata* elongated, sinuous. *Basidiospores* subglobose (Q = 0.8 - 0.9), 6.5 - 8 x 7.5 - 9 µm, germination not seen.

SPECIMEN EXAMINED: **DOMINICAN REPUBLIC**: La Vega, Valle Nuevo, on old pyrenomycete stroma on dead attached twig of shrub, 1 June 1997, *Roberts* GA118, **K(M) 97027**.

Numerous taxa associated with pyrenomycetes have been described within the *Tremella indecorata* group (Chen 1998), but they are poorly differentiated and it is not clear which, if any, represent distinct species. The collection from the Dominican Republic, cited above, produced small, hyaline-whitish basidiomes and grew over the remains of an ascomycete stroma (too old and degraded for identification). Based on a re-examination of the Norwegian type, the new collection differs from *T. indecorata*, if at all, in having a proportion of broader hyphae up to 6.5 µm wide. The basidia and basidiospores are very similar. For the time being, therefore, the Dominican Republic collection is referred to *T. indecorata*, the earliest valid name. A collection from Cameroon was described and illustrated in Roberts (2001).

Tremella mesenterica *Retz.* in Kongl. Vet. Acad. Handl. 30: 249 (1769)

SPECIMENS EXAMINED: **DOMINICAN REPUBLIC**: La Vega, road to Valle Nuevo, on dead attached twigs with *Peniophora* sp., 1 June 1997, *Roberts* GA142, **K(M) 86324**; same details, *Roberts* GA141, **K(M) 107422**.

Tremella mesenterica is a cosmopolitan species, bright yellow and lobate, associated with mycelia of the corticioid genus *Peniophora*. Several specimens were seen at the location cited above. The species was described and illustrated from England in Roberts (1995).

Tremella rhytidhysteri *J.L. Bezerra & Kimbr.* in Can. J. Bot. 56: 3023 (1978)

This is a small, brown, pustular species with bisterigmate basidia and subglobose basidisopores growing on the ascomycete *Rhytidhysterium rufulum* on wood. A specimen from Santiago province was recorded by Bezerra & Kimbrough (1978).

TULASNELLALES

Tulasnella eichleriana *Bres.* in Ann. Mycol. 1: 113 (1903)

SPECIMEN EXAMINED: **DOMINICAN REPUBLIC**: La Vega, Valle Nuevo, on fallen twig, 1 June 1997, *Roberts* GA100, **K(M) 86059**.

This is a cosmopolitan species or species complex, described and illustrated in Roberts (1994). It can be recognized by its effused, ceraceous, grey-violaceous basidiomes, clampless hyphae, and small, subglobose to ellipsoid basidiospores.

Tulasnella thelephorea *(Juel) Juel* in Arkiv. Bot. 14: 8 (1914)

SPECIMEN EXAMINED: **DOMINICAN REPUBLIC**: La Vega, Valle Nuevo, on rotten, fallen wood, 1 June 1997, *Roberts* GA325, **K(M) 85964**.

Tulasnella thelephorea is distinguished by its effused, subgelatinous, grey-violaceous basidiomes, clamped hyphae, and oblong basidiospores. The species was described and illustrated in Roberts (1994).

DUBIOUS & EXCLUDED SPECIES

Auricularia auricula-judae *(Bull.) Wettst.*, Cat. Rais. Plantes Cellul. Tunisie: 75 (1897)
Auricularia auricula (L.) Underw. in Mem. Torrey Bot. Club. 12: 15 (1902)

Auricularia auricula-judae was reported from the Dominican Republic by Berkeley (1852) and Ciferri (1961), the latter using the name *A. auricula* (an unsanctioned epithet). Berkeley's specimens are of *A. cornea* (see above) and Ciferri's may also represent this species. In his monographic study of *Auricularia*, Lowy (1952) noted that *A. auricula-judae*, a temperate species, was frequently reported from the tropics, but that no tropical specimen he had examined was accurately determined.

Calocera divaricata *Berk* in J. Bot. 1: 140 (1842)

The collection (*Sallé* 70) of *Calocera divaricata* reported from the Dominican Republic by Berkeley (1852) has been re-examined and redetermined as the holobasidiomycete *Scytinopogon pallescens* (Bres.) Singer.

Helicogloea lagerheimii *Pat.* in Bull. Soc. Mycol. France 8: 121 (1892)

This species was reported by Ciferri (1961) on rotten leaves from La Cumbre in La Vega province, but the substratum is atypical and the spore size quoted ("13 - 16 x 5 - 7 µm") is too large for this species. A supporting specimen was not noted.

Tremella rufolutea *Berk. & M.A. Curtis* in J. Linn. Soc. Bot. 10: 341 (1868)

Tremella rufolutea was reported from the Dominican Republic by Ciferri (1961) with the comment "observed and rare. May be a form of some *Auricularia*", though there is no note of a supporting specimen. The type collection from Cuba has been re-examined and is a species of the Dacrymycetales.

Tulasnella violea *(Quél.) Bourdot & Galzin* in Bull. Soc. Mycol. France. 25: 31 (1909)

For many years, the main reference paper for *Tulasnella* species was that of Rogers (1933). Rogers had a wide-ranging concept of *T. violea* which included the smaller-spored *T. eichleriana* (see above). A record of *T. violea* in Ciferri (1961) is therefore uncertain and may be referable to *T. eichleriana*.

ACKNOWLEDGMENTS

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MYCOTAXON

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A MYCOLOGICAL SURVEY OF THE APHYLLOPHORALES (BASIDIOMYCOTINA) OF THE ATLANTIC RAIN FOREST IN THE STATE OF PERNAMBUCO, BRAZIL

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ABSTRACT: Forty species of Aphyllophoralles are reported from the Atlantic Rain Forest of Pernambuco, Brazil. Thirteen of them are recorded for the first time for the state.

KEY-WORDS: Ganodermataceae, Hymenochaetaceae, Lachnocladiaceae, Podoscyphaceae, Polyporaceae, Schizophyllaceae, Stereaceae

INTRODUCTION

The Atlantic Rain Forest (Mata Atlântica) is a coastal ecosystem characterised by high specific diversity (Ministério do Meio Ambiente, dos Recursos Hídricos e da Amazônia Legal, 1998). Due to its location, it has suffered strong impact by colonisation and urbanisation, which almost led to its extinction. Originally covering 1.130.000km^2 and distributed over 17 of the 26 Brazilian states, today only 9,0% of its original area is remaining. In the state of Pernambuco, the forest is reduced to only to about 8,5% of its original area (Ministério do Meio Ambiente, dos Recursos Hídricos e da Amazônia Legal, 1998).

Although there are many reports involving different aspects of the Atlantic Rain Forest (Monteiro & Kaz, 1992; Coimbra-Filho & Câmara, 1996), there are few mycological studies of fungi in this ecosystem (Loguércio-Leite & Gerber, 1997; Soares & Gugliotta, 1998; Gugliotta & Bononi, 1999; Gerber & Loguércio-Leite, 2000; Góes-Neto et al., 2000). The same is the case for the state of Pernambuco (Cavalcanti, 1976; Silva & Minter, 1995; Gibertoni & Cavalcanti, 2000).

The aim of this work is to increase the knowledge of the diversity of Aphyllophorales in the Atlantic Rain Forest of the state of Pernambuco, Northeast Brazil.

MATERIAL AND METHODS

The state of Pernambuco covers an area of 98.281 km^2, of which 1524,3 km^2 present remnants of the Atlantic Rain Forest (Ministério do Meio Ambiente, dos Recursos Hídricos e da Amazônia Legal, 1998).

Collections of Aphyllophorales *sensu latu* were made from September 1997 to October 1998 in three areas of the Atlantic Rain Forest: Reserva Ecológica de Dois Irmãos, Recife Municipality (8°03'14"S and 35°57'00"W); Mata de Gurjaú, Cabo de Santo Agostinho Municipality (8°14'12"S and 35°03'00"W); and Estação Ecológica de Tapacurá, São Lourenço da Mata Municipality (8°00'08"S and 35°13'00"W).

Collections, preparation of the material and micro- and macroscopic analyses were made following the usual proceedings for these fungi (Maerz & Paul, 1950; O. Fidalgo & Bononi, 1989; Martin, 1934; Kotlaba & Pouzar, 1964; Singer, 1951; Teixeira, 1995).

For identification the following bibliography was used: Bononi, 1979, 1984a, b; Burt, 1918, 1919, 1920, 1924; Cavalcanti, 1976; Chamuris, 1988; Cooke, 1961; Corner, 1950; Cunningham, 1956a, b; O. Fidalgo, 1968b; Gilbertson & Ryvarden, 1986, 1987; Gugliotta *et al*., 1996; Gugliotta, 1997; Larsen & Cobb-Poule, 1990; Lowe, 1958, 1963; Overholts, 1967; Parmasto, 2001; Pegler, 1973; Petersen, 1973; Pouzar, 1972; Reeves & Welden, 1967; Reid, 1965; Ryvarden, 1976a, b; Ryvarden, 1991; Ryvarden & Gilbertson, 1993a, b; Ryvarden & Joahnsen, 1980; Ryvarden *et al*., 1982; Sousa, 1980; Talbot, 1954a, b, 1973; Teixeira, 1993, 1994; Wright & Blumenfeld, 1984.

RESULTS

Forty species belonging to thirty-two genera and seven families of Aphyllophorales were collected. Thirteen of them are recorded for the first time for the state of Pernambuco and are marked with *. All specimens are deposited in (URM).

GANODERMATACEAE

Amauroderma omphalodes (Berk.) Torrend,
Broteria, Ser. Bot. 18: 131, 1920.
BASIONYM: *Polyporus omphalodes* Berk., 1856.
DISTRIBUTION: South America (Cavalcanti, 1976).

Ganoderma applanatum (Pers.) Pat.,
Bull. Soc. Mycol. Fr. 5: 67, 1889.
BASIONYM: *Boletus applanatus* Pers., 1799.

DISTRIBUTION: Cosmopolitan (Lucena, 1988).

Ganoderma lucidum (W. Curtis: Fr.) P. Karst.,
Revue Mycol. 3(9): 17, 1881.
BASIONYM: *Polyporus lucidus* W. Curtis: Fr., 1821.
DISTRIBUTION: Cosmopolitan (Lucena, 1988).

Ganoderma resinaceum Boud. *in* Pat.,
Bull. Soc. Mycol. Fr. 5: 72, 1889.
DISTRIBUTION: Cosmopolitan (Lucena, 1988).

HYMENOCHAETACEAE

**Aurificaria luteo-umbrina* (Rom.)D.A. Reid,
Kew Bull. 17: 279, 1963.
BASIONYM: *Phaeoporus luteo-umbrina* Rom., 1901.
DISTRIBUTION: Australia, South America and USA.
Remarks: Published as *Phellinus aureobruneus* J. E. Wright & Blumenf. by Gibertoni & Cavalcanti (2000).

**Dichochaete setosa* (Sw.: Fr.) Parmasto,
Folia Crypt. Estonica 37, 2001.
BASIONYM: *Thelephora setosa* Sw., 1806.
DISTRIBUTION: Mexico, Costa Rica, Cuba, Dominica, Jamaica, Puerto Rico, Trinidad, Argentina, Brazil, Chile, Colombia, Ecuador, Venezuela, India, Nepal (Parmasto, 2001).

**Hymenochaete luteobadia* (Fr.) Höhn. & Litsch.,
K. Akad. Wiss. Wien Sitzsungsber 116: 750. 1907.
BASIONYM: *Thelephora luteobadia* Fr., 1830.
DISTRIBUTION: USA, Mexico, El Salvador, Honduras, Cuba, Jamaica, Dominica, Grenada, Guadeloupe, Puerto Rico, Santa Lucia, Argentina, Brazil, Ecuador, Guyana, Surinam, Peru, Venezuela, Central African Republic, Gabon, Réunion, South Africa, China, India (Burt, 1918; Reeves & Welden, 1967; Parmasto, 2001).

Phellinus fastuosus (Lév.) Ryvarden, Norw. J. Bot. 19: 234, 1972.
BASIONYM: *Polyporus fastuosus* Lév., 1844.
DISTRIBUTION: Pantropical (Ryvarden & Johansen, 1980).

Phellinus gilvus (Schwein.: Fr.) Pat.,
Essai Taxon., p. 97, 1900.
BASIONYM: *Polyporus gilvus* Schwein.: Fr., 1828.
DISTRIBUTION: Cosmopolitan (O. Fidalgo & M. Fidalgo, 1968).

**Phylloporia pectinata* (Klotzsch) Ryvarden,
Synopsis Fungorum 5: 196, 1991.
BASIONYM: *Polyporus pectinatus* Klotzsch, 1833.
DISTRIBUTION: Pantropical (Larsen & Cobb-Poule, 1990).

LACHNOCLADIACEAE

**Lachnocladium schweinfurtianum* P. Henn.,
Engl. Jahrb. 17: 21, 1893.
DISTRIBUTION: Tropical (Welden & Ovrebo, 1989).

PODOSCYPHACEAE

Caripia montagnei (Berk.) Kuntze,
Rev. Gen. Pl. 3: 451, 1898.
BASIONYM: *Hypolyssus montagnei* Berk., 1842.
DISTRIBUTION: Neotropical (Burt, 1924; Corner, 1950; Cortecuisse *et al.*, 1996).

**Cymatoderma dendriticum* (Pers.) D. A. Reid,
Kew Bull. 13: 523, 1958 (1959).
BASIONYM: *Thelephora dendritica* Pers. *in* Gaud., 1826.
DISTRIBUTION: Pantropical (Burt, 1924; Boidin, 1959; Reid, 1965).

**Podoscypha fulvo-nitens* (Berk.) D. A. Reid,
Beih. Nova Hedw. 18: 176, 1965.
BASIONYM: *Stereum fulvo-nitens*, Berk., 1852.
DISTRIBUTION: Central and South America (Reid, 1965).

POLYPORACEAE

**Antrodiella duracina* (Pat.) Lindblad & Ryvarden,
Mycotaxon 71: 336, 1999.
BASIONYM: *Leptoporus duracinus* Pat., 1902.
DISTRIBUTION: Central America and Caribbean Islands (Lindblad & Ryvarden, 1998) and Brazil (Ryvarden & Meijer, 2002).

Coriolopsis rigida (Berk. & Mont.) Murrill, North Am. Fl. 9: 75, 1908.
BASIONYM: *Trametes rigida* Berk. & Mont., 1849.
DISTRIBUTION: Tropical Africa and America (Ryvarden & Johansen, 1980).

Datronia caperata (Berk.) Ryvarden,
Mycotaxon 23: 172, 1985.
BASIONYM: *Polyporus caperatus* Berk., 1839
DISTRIBUTION: Pantropical (Gugliotta, 1997)

**Dichomitus cavernulosus* (Berk.) Masuka & Ryvarden,
Mycol. Research 103: 1127, 1999.
BASIONYM: *Polyporus cavernulosus* Berk., 1856
DISTRIBUTION: Tropical America and Africa (Gilbertson & Ryvarden, 1987).

Earliella scabrosa (Pers. *in* Gaudich.) Gilbn. & Ryvarden,
Mycotaxon 22: 364, 1985.
BASIONYM: *Polyporus scabrosus* Pers. *in* Gaudich., 1827.
DISTRIBUTION: Tropical and subtropical zones (Gilbertson & Ryvarden, 1986).

Flabellophora obovata (Jungh.) Núñez & Ryvarden,
East Asian Polypores 2: 294, 2001.
BASIONYM: *Polyporus obovatus* Jungh., 1838.
DISTRIBUTION: Pantropical (Ryvarden & Johansen, 1980).

Fomes fasciatus (Sw.: Fr.) Cooke,
Grevillea 14(69): 21, 1885.
BASIONYM: *Polyporus fasciatus* Sw.: Fr., 1821.
DISTRIBUTION: Neotropical (Gugliotta, 1997).

Fomitella supina (Sw.: Fr.) Murrill,

Bull. Torrey Bot. Club 32: 365, 1905.
BASIONYM: *Polyporus supinus* Sw.: Fr., 1821.
DISTRIBUTION: Tropical America (Cavalcanti, 1976).

Hexagona hydnoides (Sw.: Fr.) M. Fidalgo,
Mem. N. Y. Bot. Gard. 17(2): 35-108, 1968.
BASIONYM: *Polyporus hydnoides* Sw.: Fr., 1821.
DISTRIBUTION: Pantropical (Gugliotta, 1997).

Lentinus crinitus (L.: Fr.) Fr.,
Syst. Orb. Veg. 77, 1825.
BASIONYM: *Agaricus crinitus* L.: Fr., 1821.
DISTRIBUTION: Pantropical (Pegler, 1983).

Lenzites stereoides (Fr.) Ryvarden,
Norw. J. Bot. 19 (4-3): 232, 1972.
BASIONYM: *Daedalea stereoides* Fr., 1851.
DISTRIBUTION: Pantropical (Ryvarden & Johansen, 1980).

**Nigrofomes melanoporus* (Mont.) Murrill,
Bull. Torr. Bot. Cl., 31: 425, 1904.
BASIONYM: *Polyporus melanoporus* Mont.
DISTRIBUTION: Pantropical (Ryvarden & Johansen, 1980).

**Nigroporus vinosus* (Berk.) Murrill,
Bull. Torrey Bot. Cl. 32: 361, 1905.
BASIONYM: *Polyporus vinosus* Berk., 1852.
Distribuition: Pantropical (Ryvarden & Johansen, 1980).

Polyporus dictyopus Mont.,
Ann. Sci. Nat., ser. 2, 3: 349, 1835.
DISTRIBUTION: Pantropical (Gugliotta *et al.*, 1996).

Polyporus leprieurii Mont.,
Ann. Sci. Nat., ser. 2, 13: 203, 1840.
DISTRIBUTION: Tropical America (Ryvarden & Johansen, 1980).

Polyporus tenuiculus (P. Beauv.) Fr.,
Syst. Mycol. 1: 344, 1821.
BASIONYM: *Favolus tenuiculus* P. Beauv., 1806.
DISTRIBUTION: Pantropical (Gugliotta, 1997).

Pycnoporus sanguineus (L.: Fr.) Murrill,
Bull. Torrey Bot. Club 31: 421, 1904.
BASIONYM: *Polyporus sanguineus* L.: Fr, 1821.
DISTRIBUTION: Pantropical (Ryvarden & Johansen, 1980).

Rigidoporus microporus (Fr.) Overeem,
Icon. Fung. Malayenesium 5: 1, 1924.
BASIONYM: *Polyporus microporus* Fr., 1821
DISTRIBUTION: Tropical America (Cavalcanti, 1976).

Trametes cubensis (Mont.) Sacc.,
Syll. Fung. 9: 198, 1891.
BASIONYM: *Polyporus cubensis* Mont., 1837.
DISTRIBUTION: Tropical America (Gilbertson & Ryvarden, 1987).

Trametes membranacea (Sw.: Fr.) Kreisel,
Ciências Biol. ser. 4, nº 16: 83, 1971.
BASIONYM: *Polyporus membranaceus* Sw.: Fr., 1821.

DISTRIBUTION: Tropical America (Gilbertson & Ryvarden, 1987).

Trametes modesta (Fr.) Ryvarden,
Norw. J. Bot. 19: 236, 1972.
BASIONYM: *Polyporus modestus* Fr., 1830.
DISTRIBUTION: Pantropical (Ryvarden & Johansen, 1980).

Trametes villosa (Fr.) Kreisel,
Ciências Biol. ser. 4, nº 16: 84, 1971.
BASIONYM: *Polyporus villosus* Sw.: Fr., 1821.
DISTRIBUTION: America, Africa and Asia (Cavalcanti, 1976).

Trichaptum abietinum (Dicks.: Fr.) Ryvarden,
Norw. J. Bot 19: 237, 1972.
BASIONYM: *Polyporus abietinus* Dicks.: Fr., 1821.
DISTRIBUTION: Europe, Asia, North America (Ryvarden, 1976b), Venezuela (O. Fidalgo, 1968a) and Brazil (Gibertoni & Cavalcanti, 2000).

SCHIZOPHYLLACEAE

Schizophyllum commune (Fr.) Fr.,
Syst. Mycol. 1: 330, 1921.
DISTRIBUTION: Cosmopolitan (Cooke, 1961).

STEREACEAE

**Lopharia cinerascens* (Schwein.) G. Cunn.,
Trans. Royal Soc. New Zealand 83: 622, 1956.
BASIONYM: *Thelephora cinerascens* Schwein., 1832.
DISTRIBUTION: America (Burt, 1920), France and Portugal (Bourdot & Galzin, 1921), Africa, Thailand and Sri Lanka, Oceania (Cunningham, 1956a).

**Stereum ostrea* (Blume & Nees: Fr.) Fr.,
Epicr. syst. mycol., p. 547, 1838.
BASIONYM: *Thelephora ostrea* Blume & Nees, 1826.
DISTRIBUTION: America, Africa, Asia and Australasia (Chamuris, 1988).

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PHYLLACTINIA PISTACIAE SP. NOV. ON PISTACIA VERA

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ABSTRACT: *Phyllactinia pistaciae* sp. nov. (= *P. suffulta* f. *pistaciae*) on *Pistacia vera*, described in this paper, is unique among taxa of the genus in having multi-celled feet on its penicillate cells found on the ascomata. Furthermore, the foot-cells of the conidiophores are spirally twisted or wavy, a feature that has been known only in *P. dalbergiae*. Detailed descriptions and illustrations of both the anamorph and the teleomorph of this species are provided.

Keywords: powdery mildew, penicillate cell, anamorph, *Ovulariopsis*, *Streptopodium*

The powdery mildew fungus on *Pistacia vera* L., a fruit tree belonging to the Anacardiaceae, had been recorded as *Phyllactinia suffulta* f. *pistaciae* Jacz. (Jaczewski, 1927). This name was merged into *P. guttata* (Wallr. : Fr.) Lév. by Braun (1987), which accommodates numerous *Phyllactinia* names on various host families.

The species concept in the genus *Phyllactinia* varies among authors (Yu and Han, 1978; Yu and Lai, 1979; Yu *et al.*, 1979; Braun, 1987; Nomura, 1997; Shin, 2000). To solve this problem, Takamatsu and his colleagues utilized molecular analysis to compare rDNA sequences of *Phyllactinia* isolates from various host plants (unpublished data).

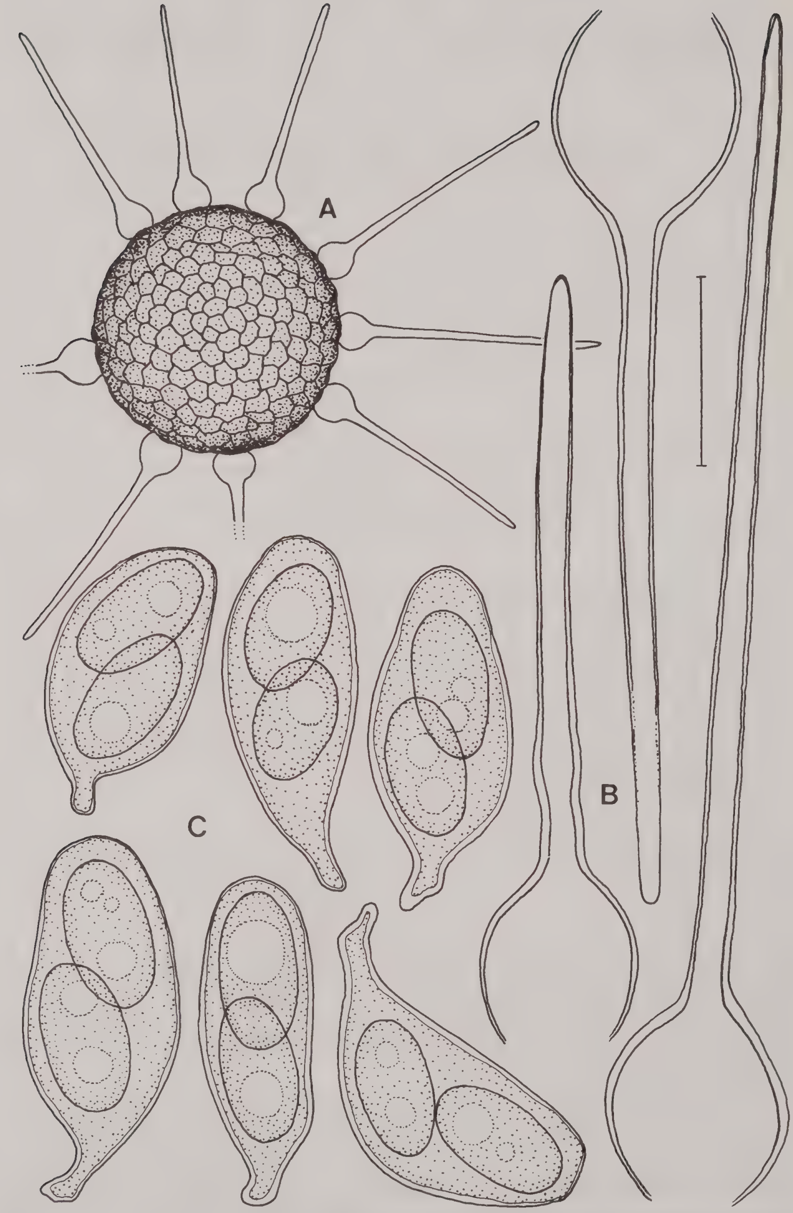

Fig. 1. *Phyllactinia pistaciae*. (A) ascoma, (B) ascomatal appendages, (C) asci with ascospores. Bar = 50 µm, but 200 µm for A.

Recently, Shin (2000) suggested that the anamorphic characteristics are different among members of this genus and could be used for species delimitation. More recently, Shin and Lee (2002) provided various morphological characters of the penicillate cells and suggested the taxonomic value of these cells for delimitation of species within *Phyllactinia*. The penicillate cells are composed of feet and filaments. The feet are cylindrical, hyaline, non-septate outgrowths of the ascomatal walls (Braun, 1987; Nomura, 1997; Shin and Lee, 2002).

During microscopic examination of *Phyllactinia* spp. deposited in SOMF (Institute of Botany, Bulgarian Academy of Sciences, Sofia, Bulgaria), we found that the feet of penicillate cells in a *Phyllactinia* sp. on *Pistacia vera* are composed of one to several cells. This character is unique among *Phyllactinia* species up to now. Two additional specimens of *Pistacia* mildews deposited in LE were examined and confirmed multi-celled feet of the penicillate cells. Therefore the present fungus is clearly differentiated from the known *Phyllactinia* species and should be treated as a distinct species.

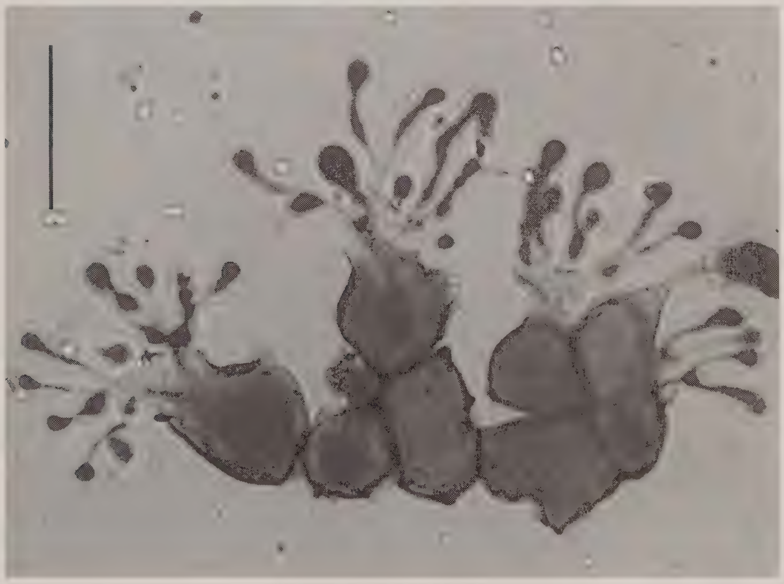

Fig. 2. The penicillate cells on the ascoma of *Phyllactinia pistaciae*. The dark color of the feet and filaments of the penicillate cells is due to lactofuchsin staining. They are originally hyaline. Bar = 50 µm.

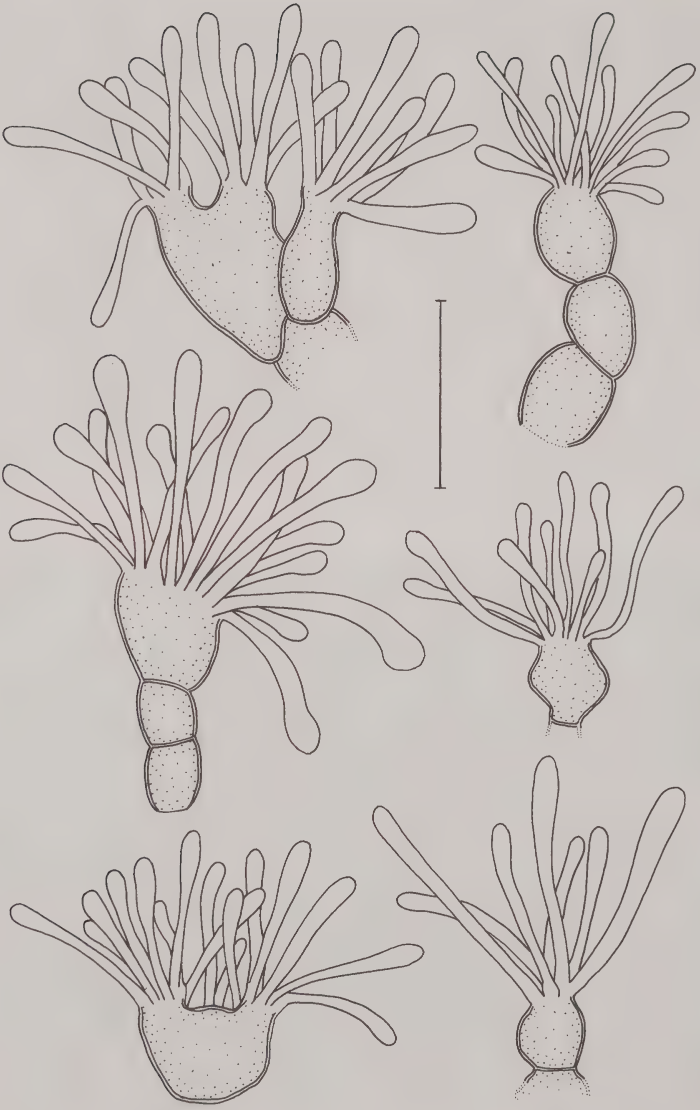

Fig. 3. Diversity of the penicillate cells in *Phyllactinia pistaciae*. Bar = 50 µm.

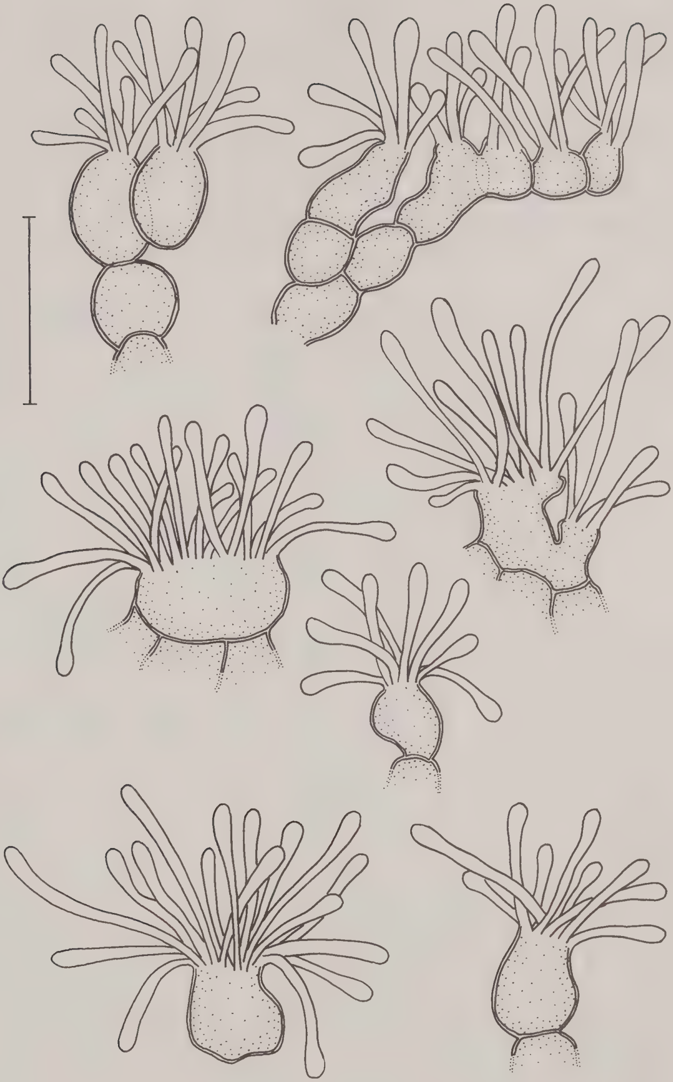

Fig. 3. continued.

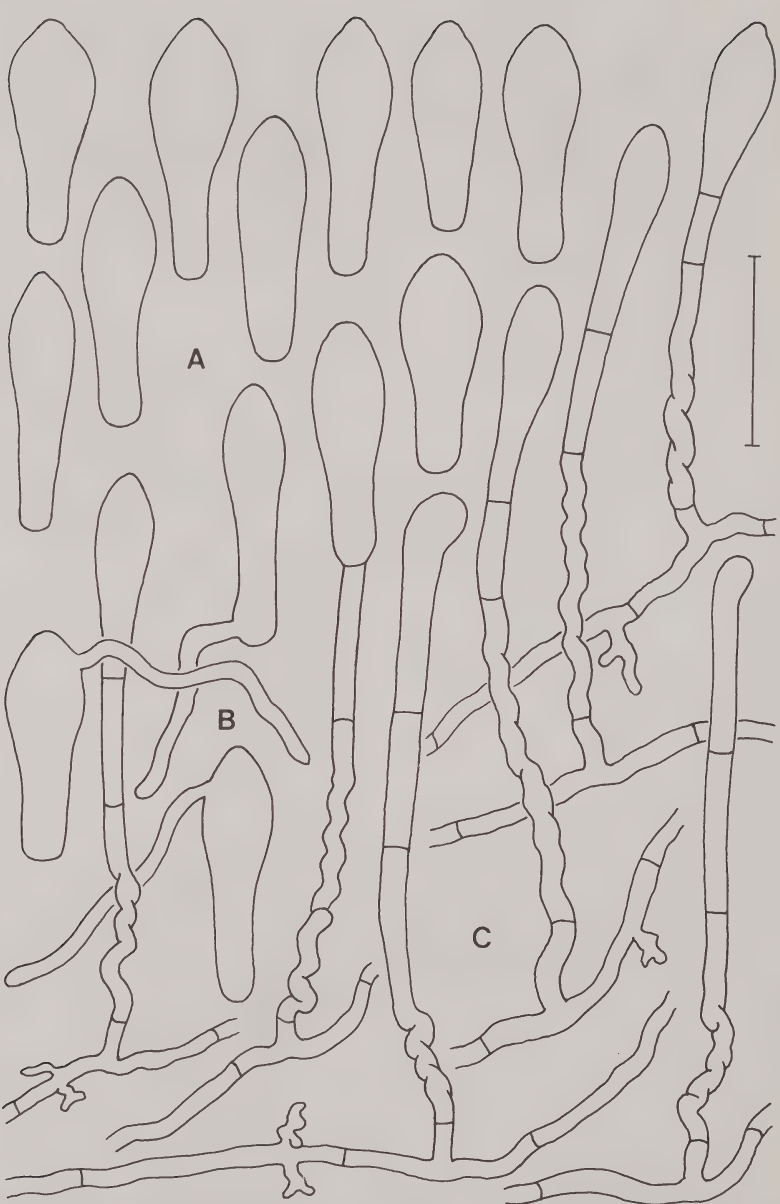

Fig. 4. *Phyllactinia pistaciae*. (A) conidia, (B) germinating conidia, (C) conidiophores. Bar = 50 µm.

Phyllactinia pistaciae H.D. Shin & Y.J. Choi, sp. nov. Figs 1-4

Syn.: *Phyllactinia suffulta* f. *pistaciae* Jacz., Karmannyj opredelitel' gribov, II. Mucnisto-rosjanye griby. p. 425 (1927)

Differt a Phyllactinia guttata 'cellulis penicillatis' cum pedibus multicellularibus et conidiophoris cum cellulis basalibus tortis vel undulatis.

Holotype: on *Pistacia vera* (Anacardiaceae), Turkmenskaya SSR, Badkhyz, cordon Kepelya, 4 Oct. 1977, V.A. Mel'nik (LE 139041).

Mycelium amphigenous, but mostly hypophyllous, conspicuous, thick or thin, subpersistent, forming irregular white patches or covering the whole lower leaf surface; **hyphae** substraight to flexuous, sometimes undulate to geniculate, 50-110 × 4-6(-10) μm, mostly branching at right angles, with a septum near the branching point; **appressoria** well-developed, hook- to rod-shaped, branched or not, wavy or lobed, single or opposite in pairs; **conidiophores** single on a hyphal cell, arising from the upper part of creeping hyphae, position mostly central, 110-240 μm long, 5-7 μm wide, mostly composed of three cells, producing conidia singly, followed by a shorter cell and a foot-cell, spirally twisted or wavy at the basal part or throughout the foot-cells, with a basal septum at 5-25 μm away from the branching point of the mycelium; **conidia** clavate, non-papillate, somewhat pointed or conically rounded at the apex, 52-72(-80) × 17.5-25 μm, without conspicuous fibrosin bodies, hyaline to subhyaline, producing germ tubes at randomly located sites; **ascomata** scattered, 220-280 μm diam., blackish brown, depressed globose; **wall-cells** irregularly polygonal to somewhat rounded, 10-25 μm wide, not distinct; **appendages** 6-13 in number, arising around the equatorial zone of the ascomata, simple, filiform with a bulbose base, 40-55 μm wide at the ball, 7-10 μm wide above the ball and gradually narrower upwards, apex 6-8 μm wide and obtuse, 0.8-1.2(-1.4) times as long as the ascomatal diam., hyaline throughout, aseptate; **penicillate cells** crowded on the upper part of the ascoma, hyaline, feet composed of one to several cells, terminal cell 16-56 × 16-40 μm, filament 12-80 μm long, 3-6 μm wide, but swollen at the apex, reaching up to 10 μm wide; **asci** (14-)18-30 in an ascoma, olivaceous brown, 60-100 × 25-40 μm, with short or somewhat long stalks, moderately thick-walled, but thinner at the upper part; **ascospores** 2 in an ascus, oval to cylindric oval, olivaceous to pale brownish, guttulate, 34-42 × 18-24 μm (l/w=1.5-1.9).

Specimens examined: LE 195815 (on living leaves of *Pistacia vera* L., 5 IX 1976, Turkmenskaya SSR, Mary Oblast, Badkhyz reserve, cordon Kepelya, coll. G.S. Malysheva); LE 139041 (holotype); SOMF 19639 (duplicate of LE 139041).

Note: The present fungus could be included in *Phyllactinia guttata* sensu Braun (1987) in the sense of ascomatal morphology (Fig. 1). The species is, however, unique within taxa of *Phyllactinia* Lév. by having multi-celled feet on the penicillate cells (Figs 2 and 3). So far the penicillate cells in this genus have been known to have single-celled feet (Braun, 1987; Nomura, 1997; Shin and Lee, 2002).

The conidiophores of this species resemble those of *Phyllactinia dalbergiae* Pirozinski and those of the species of *Pleochaeta* Sacc. & Speg. (*Streptopodium* anamorph) by having spirally twisted or wavy foot-cells (Fig. 4). Though Zheng and Chen (1978) as well as Gorter and Eicker (1983) placed the anamorph of *P. dalbergiae* in the genus *Streptopodium*, Braun (1987) suggested that the anamorph of *P. dalbergiae* be placed in *Ovulariopsis*. We agree with his idea. The conidia of *P. pistaciae* are clavate and hence in full accordance with the various *Ovulariopsis* states found within *Phyllactinia*.

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NIVICOLOUS MYXOMYCETES FROM THE SIERRA NEVADA NATIONAL PARK (SPAIN)

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Abstract: The first results of studies of nivicolous Myxomycetes from the National Park of Sierra Nevada (Spain) are presented. They are the most southern records from Europe. 16 different taxa were collected of 169 samples, two of them are new records for the Iberian Peninsula: *Didymium nivicolum* and *Physarum alpinum*. Detailed descriptions of taxa that are new to Spain or difficult to distinguish are given including SEM micrographs of spore ornamentation.

Key words: chorology, *Diderma*, *Didymium*, *Lamproderma*, *Lepidoderma*, *Physarum*, SEM, taxonomy

INTRODUCTION

The National Park of Sierra Nevada is located in the south of the Iberian Peninsula, in the provinces of Granada and Almeria, with an area of 86,208 hectares. Since 1986 it is Reserve of the Biosphere and it was declared as a National Park in 1999 owing to its geological interest, its very fragile biological richness due to the critical environmental conditions, and to emphasise the mountain and high mountain flora of the Mediterranean Region.

Sierra Nevada is an area characterised by having the tallest peaks of the Iberian Peninsula, the Mulhacen (3,482 m) and Veleta (3,392 m). Its formation was generated in a compressible process during the Alpine folding. Large slipping mantles and metamorphic rocks of paleozoic age are the main geological components. The typical modelled glacier appears in its highest peaks.

Sierra Nevada is an exceptional refuge for the biodiversity in the European continent. It presents the richest and most varied flora in all the western Mediterranean region with a total amount of 2,100 described higher plants, which represents one third of the whole Spanish flora. We must also take into account that 176 of these plants are endemic Iberian species and 66 are only found in Sierra Nevada.

This floristic richness is due not only to its own geologic history, but also to the great variety of environmental factors, such as climate, orography, geography, etc. From the biogeographic point of view, it has a strategic location, both by its location in the west of the Mediterranean region and by its relative geographic isolation that, together with its diverse ecological factors, has favoured the speciation processes. It is for these reasons that the Sierra Nevada has been studied by numerous botanists such as Boissier and Willkomm, to mention just two.

Above 2,800-2,900 m altitude, snow is present for about 9 months a year. The characteristic vegetation consists of the psycroxerophytic grasslands, formed by species of low growth (*Arenaria nevadensis*, *Erigeron frigidus*, *Festuca indigesta*, *Narcisus nevadensis*), the majority of which are endemic. At this altitude there are abundant movable rocky places and the species adapted to the continuous displacement of stones live by means of the development of long roots.

At lower altitudes, between 1,900 m and 2,900 m, the landscape changes. The communities of "piornal" (*Juniperus comunis* subsp. *nana*, *Juniperus sabina* and *Genista versicolor*, etc.) become dominant. These scrubs serve as refuge to numerous animal species. At these altitudes with surrounding streams and high mountain lagoons appears the hygrophilous grassland, which is known as “borreguil” and is formed by exclusively endemic, central European and Iberian-North-African species such as *Plantago nivalis*, *Luzula nevadensis* or *Nardus stricta*.

From May to August in 2001, we made several botanical excursions with the purpose of collecting nivicolous Myxomycetes from near melting snow in the highest zones of the Sierra Nevada.

Although these references are not the only ones from Sierra Nevada, certainly they are the first references known on nivicolous Myxomycetes in this area, except the record of *Diderma niveum* (ORTEGA & CALONGE, 1980).

MATERIALS AND METHODS

The studied material generally has been collected by the authors of the present work and, where collected by other authors, it is indicated in the corresponding paragraph. All the localities where specimens were collected belong to the municipality of Güéjar-Sierra in the province of Granada (Fig. 1):

1.- "Hoya de la Mora" (2,500-2,625 m).
2.- "Cabecera Barranco de San Juan" (2,950 m).
3.- "Ventisquero Barranco Morón" (2,700-2,750 m).
4.- "Cauchiles". (2,700-2800 m).

The specimens are deposited in the herbarium of the "Departamento de Biología Vegetal, Universidad de Alcalá, Alcalá de Henares" (AH), Spain. A species description is given only if it is either considered of special interest or a new record for the Iberian Peninsula.

The collected material was mounted in Hoyer's medium and studied with a Nikon (Optiphot) microscope. Scanning electron microscopy (SEM) micrographs were made with a Zeiss DSM-950. Spore measurements were made under the oil immersion objective and include surface structures such as spines or warts.

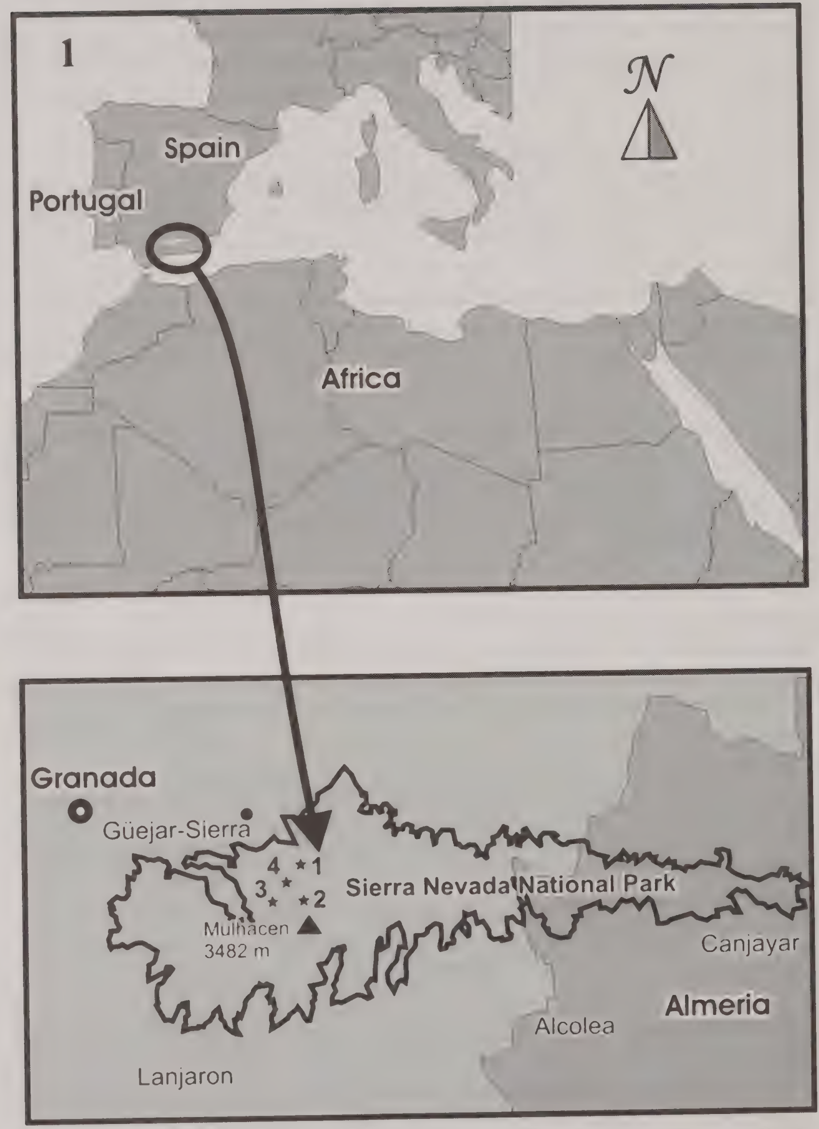
SEM-preparation: Sporocarps were rehydrated in concentrated ammonium hydroxide (28-30%) for 30 minutes, dehydrated in aqueous ethanol (70%) for 30 minutes, fixed for 2 hours in pure ethylene glycol dimethyl ether (= 1,2-dimethoxymethane) and finally immersed in pure acetone for at least 2 hours followed by critical point drying and sputtering with gold-palladium.

The terminology of the spore-producing stages follows DÖRFELT & MARX (1990) and LADO & PANDO (1997). The spore wall ornamentation as seen in the SEM is described according to the terminology proposed by RAMMELOO (1975a, b). The abbreviations for author citations follows KIRK & ANSELL (1992).

TAXONOMY

Diderma alpinum **(Meyl.) Meyl.**, *Bull. Soc. Soc. Vaud. Sci. Nat.* 51: 261. 1917.

Material examined. Sierra Nevada, Hoya de la Mora, 2,600 m, 10.V.2001, on *Cytisus oromediterraneus* Rivas Mart. et al., AH 29023, AH 29031 (with *Lamproderma maculatum*), AH 29041; *ibidem*, 11.V.2001, AH 29028, AH 29100, AH 29114.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Granada
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Sierra Nevada National Park
Mulhacen
3482 m
Canjayar
Almeria
Alcolea
Lanjaron

Fig. 1: Map showing the location of the national park of Sierra Nevada and the localities from where material has been studied.

Remarks. *Diderma alpinum* is a species belonging to the *D. niveum* complex which was proposed by MORENO et al. (2003) and includes nivicolous taxa of *Diderma* with sessile, white sporocarps and crustose peridia. This species differs from the rest of the species included in this complex by its sporocarps being more than 1 mm in diam., having flexuous, hyaline to somewhat dark capillitium, about 1 µm in diam., and 11-13 µm diam. spores which appear spinose by LM, baculate by SEM.

From the Iberian peninsula *Diderma alpinum* was cited from Barcelona (GRÀCIA, 1987), Lérida (GORRIS et al., 1999), Madrid and Segovia (MORENO et al., 2003), like already indicated in SÁNCHEZ et al. (1997).

***Didymium difforme* (Pers.) Gray**, *Nat. Arr. Brit. Pl.* 1: 571. 1821.

Material examined. Sierra Nevada, Barranco Morón, 2,750 m, 26.VII.2001, on stems of *Astragalus* sp., AH 19688.

Remarks. *Didymium difforme* is characterised by its sessile, flat sporocarps or sometimes short plasmodiocarps and its double peridium with a crustose, *Diderma*-like outer wall which is composed of densely aggregated lime crystals.

This cosmopolitan species prefers decomposing plants and appears both in lowlands and alpine areas. A SEM-study was realized by LIZÁRRAGA et al. (1999).

According to BOZONNET et al. (1991) *Didymium difforme* is not a strictly nivicolous species.

***Didymium dubium* Rostaf.**, *Sluzowce Monogr.*: 152. 1874.

Material examined. Sierra Nevada, Hoya de la Mora, 2,600 m, 10.V.2001, on *Carduus carlinoides* Gouan, AH 29026, AH 29043, AH 29052, AH 29058, AH 29062, AH 29064; *ibidem*, on dry stems, AH 29040, AH 29060, AH 29094; *ibidem*, Barranco Morón, 2,750 m, 26.VII.2001, on *Carduus carlinoides* Gouan, AH 29283; *ibidem*, on *Digitalis purpurea* L., AH 30028; *ibidem*, Ventisquero del Barranco Morón, AH 19631; *ibidem*, Hoya de la Mora, on stems of Lamiaceae, AH 30030; *ibidem*, Cabecera del Barranco de San Juan, 2,950 m, 27.VII.2001, AH 29095, AH 30031; *ibidem*, on *Carduus carlinoides* Gouan, AH 29143, AH 29145, AH 30029; *ibidem*, 13.VIII.2001, on industrial wood, AH 29278; *ibidem*, Cauchiles, 2,800 m, 14.VIII.2001, on *Carduus carlinoides* Gouan, AH 29284, AH 29286.

Remarks. *Didymium dubium* is abundant at high altitudes in the Sierra Nevada and is characterised by its 10-15 µm diam. spores bearing warts arranged in lines which are more or less subreticulate and clearly visible with SEM (SINGER et al., 2001a). The capillitium is variable, colourless to dark, branching, with dark nodes and straight or curved threads which sometimes bear spiral bands, the free ends are pointed and rarely expanded.

The specimen AH 29052 has spores of variable size, 16-35 µm, possibly because of a irregular development in the field. We have frequently observed similar giant spores in other nivicolous species, which have confounded some specialists and who have created numerous new specific or infraspecific taxa that are of no taxonomic significance.

Didymium decipiens Meyl. is a very closely related species which differs from *D. dubium* in its capillitium having *Trichia*-like spiral bands and its dark peridium. However, the spore diameters and spore ornamentation are very similar and merge into the variability of *D. dubium*.

Didymium dubium is a cosmopolitan species, found frequently on dead wood, leaves and decomposing plants, in both lowland and alpine areas. According to BOZONNET et al. (1991) *D. dubium* is – like *D. difforme* - not strictly nivicolous.

***Didymium nivicolum* Meyl.**, *Bull. Soc. Vaud. Sci. Nat.* 57: 40. 1929.

Figs. 2-3

Material examined. Sierra Nevada, Cabecera del Barranco de San Juan, 2,950 m, 27.VII.2001, on *Carduus carlinoides* Gouan, AH 19667, AH 19668, AH 19669, AH 19670, AH 19673, AH 19674, AH 29285, AH 30025, AH 30026; *ibidem*, 3,000 m, on *Ptilotrichum spinosum* (L.) Boiss., AH 19672; *ibidem*, Ventisquero Barranco Morón, 2,700 m, AH 19675; *ibidem*, 13.VIII.2001, on *Carduus carlinoides* Gouan, AH 29275; *ibidem*, 2,975 m, 14.VIII.2001, AH 29280; *ibidem*, 3,000 m, AH 29274, AH 29281; *ibidem*, Cauchiles, 2,800 m, AH 29282.

Description: Plasmodiocarps rounded, broadly spread, flattened, reaching 4 cm in length, together with flattened, spherical sporocarps reaching 2 mm in diam., snow white, limeless forms drab to brown with metallic shine. Hypothallus membranous, inconspicuous or distinct when

Figs. 2-3: *Didymium nivicolum* Meyl., (AH 19673). 2. Spore. 3. Detail of spore ornamentation. **Figs. 4-5:** *Lepidoderma chailletii* Rostaf., (AH 29047), 4. Spore. 5. Detail of spore ornamentation. **Figs. 6-7:** *Lepidoderma granuliferum* (W. Phillips) R. E. Fr., (AH 29288), 6. Spore. 7. Detail of spore ornamentation.

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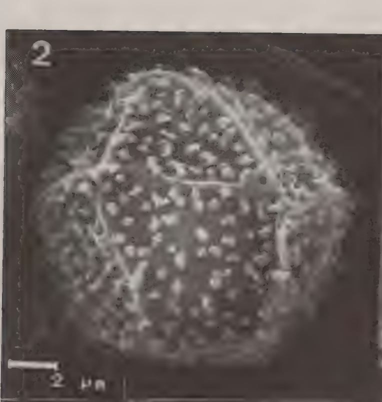

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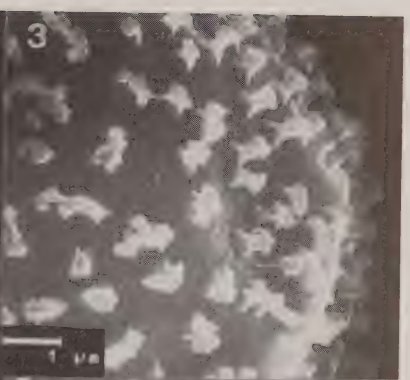

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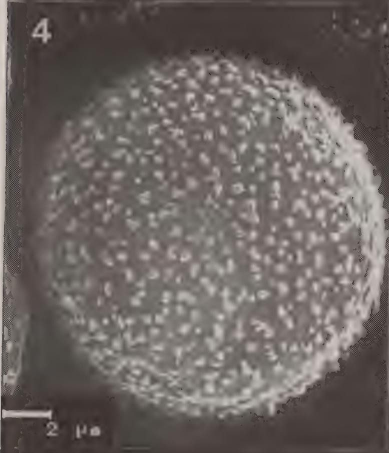

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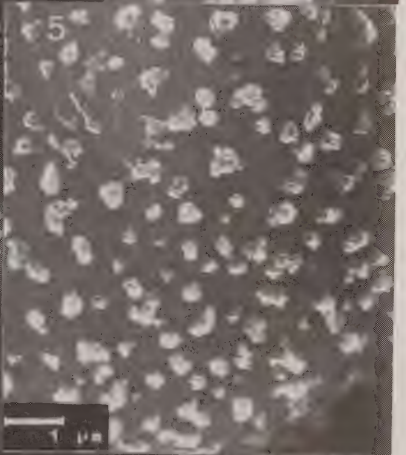

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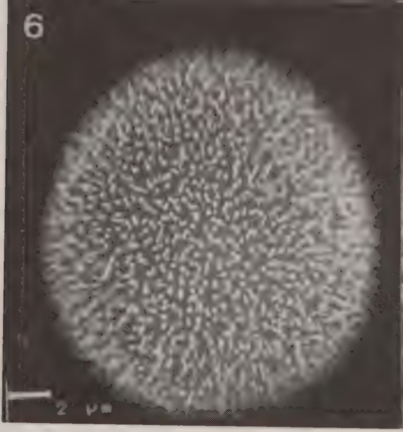

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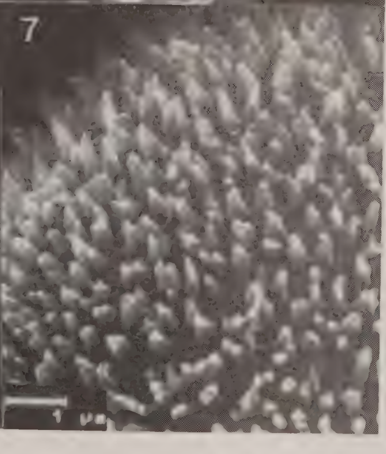


covered with lime crystals. Outer peridium consisting of floccose aggregations of stellate lime crystals, inner peridium membranous, wrinkled, drab and shiny. Columella absent or present as a small elevation in sporangiate forms or a low longitudinal ridge in plasmodiocarpous forms, with a rough surface, whitish, yellowish to sandy. Capillitium abundant, not elastic, radiating, straight or, more commonly, wavy, sparsely branched, with a few lateral connecting bars, hyaline to brown with isolated darker nodes about 2 µm in diam. Spores black in the mass, dark brown by transmitted light, globose, (11-)12-16(-18) µm in diam., with irregularly distributed, coarse warts or spines, which are sometimes arranged in short lines forming a polyhedric arrangement. In SEM, baculae with flattened apices are observed.

Remarks. *Didymium nivicolum* is well characterised by its flat plasmodiocarps, sometimes mixed with small sporocarps, with a rough, white peridium, and its typical, strongly ornamented spores, bearing lines which form a polyhedric arrangement, which can vary in the collections from (11-)12-14 µm to 14–16(-18) µm. With SEM we observe baculae with flattened apices exactly like the ornamentation observed in material from the Austrian Tyrol (SINGER et al., 2001a).

This is a nivicolous species typically found on herbaceous plants, mainly of the family Asteraceae. In Sierra Nevada this species is frequently collected on *Carduus carlinoides* (Asteraceae) and sometimes on *Ptilotrichum spinosum* (Brassicaceae).

This is a new record for Spain.

***Lamproderma cribrarioides* var. *atrosporum* (Meyl.) G. Moreno, H. Singer, Illana & A. Sánchez**, *Österr. Z. Pilzk.* 12: in press. 2003.
= *L. atrosporum* Meyl., *Bull. Soc. Vaud. Sci. Nat.* 46: 51. 1910.

Material examined. Sierra Nevada, Hoya de la Mora, 2,600 m, 11.V.2001, on *Pinus uncinata* Ramond ex DC. in Lam. & DC., AH 29113, AH 29120, AH 29121, AH 29122, AH 29128 AH 29129; *ibidem*, on *Cytisus oromediterraneus* Rivas Mart. et al., AH 29125, AH 29139.

Remarks. The distinct characteristic of *Lamproderma cribrarioides* var. *atrosporum* is its dark capillitium with funnel-shaped ends attached to small pieces of the black, usually evanescent peridium. The spore ornamentation is very variable and was described by SINGER et al. (2001b) as spinose, spinulose or showing a subreticulate to completely reticulate pattern with distinct crests. Completely reticulate spores show similarity to the spore ornamentation of *Lamproderma retirugisporum*, which differs in its globose sporothecae and its lax capillitium without funnel-shaped ends. The variable spore ornamentation is accompanied by differences in spore size, which varies from 12 to 18 µm. Further information on this regard can be found in the work of SINGER et al. (2003).

This species was cited from Spain by CABO (1998), SÁNCHEZ et al. (1999), GORRIS et al. (1999) and MORENO et al. (2002).

***Lamproderma cribrarioides* (Fr.) R. E. Fr.**, *Svensk. Bot. Tidskr.* 4: 259. 1911.
= *Lamproderma atrosporum* var. *pseudocribrarioides* Mar. Mey., G. Moreno, A. Sánchez, H. Singer & Illana, *Fungi non deliniati* 19: 22. 2002.

Material examined. Sierra Nevada, Hoya de la Mora, 2,500 m, 10.V.2001, on stems and inflorescences of *Eryngium glaciale* Boiss., AH 29035, AH 29039; *ibidem*, 11.V.2001, on *Cytisus oromediterraneus* Rivas Mart. et al., AH 29136, AH 29152; *ibidem*, 14.VII.2001, AH 19660 (holotype of *Lamproderma atrosporum* var. *pseudocribrarioides*). **GERMANY:** Thüringen, near Arnstadt, on *Lycopodium annotinum* L., *leg.* LUCAS, UPS (F-015302) 230713, holotype of *Stemonitis cribrarioides* Fr.

Remarks. The specimens with spores bearing a complete reticulation show two types of spore ornamentation as observed by SEM: irregular ridges with spongy, aqueduct-like perforations in the lower part, or completely closed bands without holes, in detail resembling the spores of *Lamproderma retirugisporum*. For all specimens with spores bearing a complete reticulation the name *L. atrosporum* var. *pseudocribrarioides* Mar. Mey., G. Moreno, A. Sánchez, H. Singer & Illana was proposed (MORENO et al., 2002). A revision of the type material of both taxa was made by SINGER et al. (2003) and *L. atrosporum* var. *pseudocribrarioides* was put in synonymy with *L. cribrarioides*.

This species was described in detail by MORENO et al. (2002) based on collections from France and Spain.

***Lamproderma echinosporum* Meyl.**, *Bull. Soc. Vaud. Sci. Nat.* 55: 241. 1924.

Material examined. Sierra Nevada, Hoya de la Mora, 2,600 m, 11.V.2001, on bark and twigs of *Pinus uncinata* Ramond ex DC. in Lam. & DC., AH 29103, AH 29111.

Remarks. *Lamproderma echinosporum* belongs to the group of *Lamproderma* with mottled peridia and is characterised by its short stalk, not attaining the height of the sporotheca, its dark capillitium with hyaline tips and its spores covered with large irregularly distributed spines reaching 1 µm (MORENO et al., 2002).

The other species with a mottled peridium are *L. acanthosporum*, which differs in its usually sessile sporocarps and its spores with larger spines up to 2 µm, *L. maculatum*, with a stalk generally exceeding the height of the sporotheca and verrucose spores, baculate under SEM, and *L. pseudomaculatum*, whose peridial spots are visible only under the microscope, further distinguished by its pale capillitium and verrucose spores.

This species was cited from Spain by SÁNCHEZ et al. (1999) and MORENO et al. (2002).

***Lamproderma maculatum* Kowalski**, *Mycologia* 62(4): 654. 1970.

Material examined. Sierra Nevada, Hoya de la Mora, 2,600 m, 10.V.2001, on *Carduus carlinoides* Gouan, AH 29024, AH 29027, AH 29031 (with *Diderma alpinum*), AH 29038, AH 29051, (with *Physarum albescens*), AH 29054, AH 29059, AH 29061, AH 29070; *ibidem*, 11.V.2001, AH 29073, AH 29148, AH 29155; *ibidem*, 2,625 m, on *Cystisus oromediterraneus* Rivas Mart. et al., AH 29126.

Remarks. *Lamproderma maculatum* is easily recognised by its peridium bearing dark depressed areas, well developed stalk, generally longer than the diameter of the sporotheca or of similar size, and its spores, baculate with SEM (MORENO et al., 2002). Other species with mottled peridium have been indicated in the observations for *L. echinosporum*.

Lamproderma maculatum was recently cited from Spain by SÁNCHEZ et al. (1999) and MORENO et al. (2002) with abundant collections.

***Lamproderma ovoideum* Meyl.**, *Bull. Soc. Vaud. Sci. Nat.* 57: 373. 1932.

Material examined. Sierra Nevada, Hoya de la Mora, 2,600 m, 10.V.2001, on *Cystisus oromediterraneus* Rivas Mart. et al., AH 29048, AH 2036, AH 29063, AH 29067, AH 29072; *ibidem*, 11.V.2001, AH 29042, AH 29075, AH 29079, AH 29083, AH 29084, AH 29085, AH 29087, AH 29088, AH 29090, AH 29096, AH 29147; *ibidem*, 2,500 m, AH 29074, AH 29076, AH 29077, AH 29078, AH 29080, AH 29133, AH 29137 (with *Physarum vernum*), AH 29138, AH 29149, AH 29150; *ibidem*, 2,550 m, AH 29075, AH 29081, AH 29082, AH 29086, AH 29089; *ibidem*, on stem, AH 29136; *ibidem*, 2,600 m, AH 29151; *ibidem*, on *Pinus uncinata* Ramond ex DC. in Lam. & DC., AH 29112, AH 29124, AH 29131.

Remarks. *Lamproderma ovoideum* is characterised by its ovoid sporothecae, its short stalk on a generally conical base, its dark capillitium arising from the length of the long columella and its large spores 13-16 µm in diam., densely baculate by SEM.

As long as type material of *Lamproderma sauteri* and *L. carestiae* are not located, it remains impossible to specify synonymy for *Lamproderma ovoideum*. Due to this problem, NEUBERT et al. (2000) recognise a *L. carestiae-ovoideum* complex, which contains all taxa sharing the same general habit and dark capillitium.

We therefore determined our collections which correspond to Meylan´s lectotype as *Lamproderma ovoideum*.

Lamproderma ovoideum was described and cited from Spain by MORENO et al. (2002), supported by abundant collections.

***Lamproderma sauteri* Rostaf.**, *Sluzowce Monogr.:* 205. 1874.

Material examined. Sierra Nevada, Hoya de la Mora, 2,550 m, 10.V.2001, on stems and inflorescences of *Eryngium glaciale* Boiss., AH 29025, AH 29029, AH 29037, AH 29044, AH 29046, AH 29053, AH 29057.

Remarks. *Lamproderma sauteri* is characterised by its generally globose sporothecae, usually brilliantly iridescent, normally stalked, its reddish brown to orange brown capillitium originating from the upper part of the columella, radiating, becoming progressively paler towards the tips, and its spiny spores 14-16 µm in diam.

Lamproderma ovoideum was first considered by KOWALSKI (1970) as a synonym of *L. sauteri*. However, after examining Meylan's material (KOWALSKI, 1975) he recognised it as a distinct taxon, but subordinated *L. ovoideum* to *L. carestiae*, creating the variety *L. carestiae* var. *ovoideum* (Ces. & De Not.) Kowalski. Like Kowalski and NEUBERT et al. (1989), we consider *L. sauteri* to be a distinct species.

The only Spanish records are from the Catalonian Pyrenees, Lérida (GRÀCIA, 1986; GORRIS et al., 1999) and from the mountains of Guadarrama, Segovia (ILLANA et al., 1993).

***Lepidoderma chailletii* Rostaf.**, *Sluzowce Monogr.:* 189. 1874. Figs. 4-5

Material examined. Sierra Nevada, Hoya de la Mora, 2,550 m, 10.V.2001, on woody stems, AH 29047

Remarks. *Lepidoderma chailletii* is characterised by its fructifications forming tightly-packed sporocarps and its dark, simple peridium covered with large, white to grey lime-scales which usually form a incomplete covering. With SEM the ornamentation consists of crowded, sometimes fused warts with irregular apices.

POULAIN et al. (2002) consider *Lepidoderma carestianum* and *L. chailletii* Rostaf. to be distinct species, and they distinguish them by the presence of a double peridium in the first and a simple peridium in the latter species and by its spores which show differences in size and ornamentation. In the current work we follow the concept of POULAIN.

In Spain *Lepidoderma chailletii* was recorded twice (LADO, 1993): by ELVIRA (1987) from Navarra, which according to LADO (1993) corresponds to *Physarum leucopus*, and by CABO (1989) from La Coruña of material which should be re-examined.

This species has been cited as *Lepidoderma carestianum* (Rabenh.) Rostaf. from the mountains of Guadarrama (SÁNCHEZ et al., 1999).

***Lepidoderma granuliferum* (W. Phillips) R.E. Fr.**, *Ark. Bot.* 6 (7): 3. 1906.
Figs. 6-7

Material examined. Sierra Nevada, Barranco Morón, 2,700 m, 13.VIII.2001, on industrial wood, AH 29292; *ibidem*, Cauchiles, 2,750 m, 14.VIII.2001, on *Carduus carlinoides* Gouan, AH 29288, AH 29289, AH 29290, AH 29291. *Badhamiopsis ainoae* (Yamash.) T.E. Brooks & H.W. Keller, Guadalajara, Anchuela del Campo, 30TWL8343, 1,150 m, bark of *Juniperus thurifera* L. cultivated in moist chamber, 3.XII.1984, *leg.* C. Lado, F. Pando & J. Portela, MA-Fungi 16124 (as *Lepidoderma granuliferum*). Guadalajara, Baides, 30TWL2138, 1,000 m, bark of *Juniperus thurifera* L. cultivated in moist chamber, 20.II.1986, *leg.* J. Checa, C. Lado & F. Pando, MA-Fungi 16133 (as *Lepidoderma granuliferum*). Segovia, Moral de Hornúez, 30TVL4893, 1,130 m, bark of *Juniperus thurifera* L. cultivated in moist chamber, 10.II.1986, *leg.* E. Blanco, MA-Fungi 16139 (as *Lepidoderma granuliferum*). Burgos, Carazo, 30TVM7047, 1,200 m, bark of *Juniperus thurifera* L. cultivated in moist chamber, 12.III.1986, *leg.* C. Lado, F. Pando & J. Portela, MA-Fungi 16146 (as *Lepidoderma granuliferum*).

Description: Plasmodiocarps broadly spread, flattened, partly somewhat wounded, reaching 4 cm in length, light brown to pink. Hypothallus membranous, thin, transparent, conspicuous due to impregnation with lime scales. Peridium usually double, rarely single, inner layer membranous, matt to shiny, outer layer membranous to subcartilaginous, light brown, covered and embedded with a thick layer of densely compacted lime scales, 10-30 µm in diam., circular, brownish with a shade of pink. Columella usually absent, when present, developing as a small raised ridge running the length of the plasmodiocarp. Capillitium abundant, attached to the inner peridium, composed of branching and anastomosing tubules which form a dense, intricate net, light brown, regularly and abundantly expanding into large vesicles 10-30 µm in diam., vesicles usually filled with large darker lime nodules, tips funnel-shaped. Spores dark brown in the mass, brown by transmitted light, uniformly coloured, globose, minutely but densely spinulose, 14-17 µm in diam. With SEM the spore ornamentation is densely spinulose.

Remarks. This species is characterised by its plasmodiocarpous fructifications with a peridium outer layer covered with brownish lime scales with a pinky shade, dense capillitium net composed of tubules bearing vesicles filled with large lime nodules and the funnel-shaped tips. The spore ornamentation with SEM of the specimens collected in Sierra Nevada coincides with the material collected in the Central System of Spain by SÁNCHEZ et al. (2002).

The citations of PANDO et al. (1990) of *Lepidoderma granuliferum* cultivated in moist chambers on living rhytidome of *Juniperus thurifera* correspond to *Badhamiopsis ainoae* (Yamash.) T.E. Brooks & H.W. Seller.

The first record for the Iberian Peninsula was made by SÁNCHEZ et al. (1999, 2002) from the mountains of Guadarrama in the provinces of Madrid and Segovia.

***Lepidoderma peyerimhoffii* Maire & Pinoy**, in Maire, Patouillard & Pinoy, *Bull. Soc. Hist. Nat. Afrique N*. 17: 140. 1926.

Material examined. Sierra Nevada, Barranco Morón, 2,750 m, 26.VII.2001, on *Carduus carlinoides* Gouan, AH 30032; *ibidem*, Cauchiles, 2,750 m, 14.VIII.2001, AH 29293.

Remarks. *Lepidoderma peyerimhoffii* is characterised by its sporocarps with a peridium consisting of three layers. The inner layer is fragile, colourless and iridescent; the middle layer white, with granulose lime depositing on the substratum, and united with the brown to orange-brown external layer (SINGER et al., 2001a).

Lepidoderma peyerimhoffii was described for the first time by MAIRE & PINOY (1926). NEUBERT et al. (1991) synonymised *L. peyerimhoffii* and *Diderma nivale* (Meyl.) Nowotny, H. Neubert & K. Baumann and combined *Diderma trevelyanii* var. *nivale* to *D. nivale*, based upon the arguments of KOWALSKI (1975) that there was no significant difference between these two species. However, this combination was incorrect as the species name proposed by MAIRE & PINOY (in MAIRE et al., 1926) has priority according article 11.2 of the International Code of Botanical Nomenclature (GREUTER et al., 2000). Therefore it was corrected by the same authors (NEUBERT et al., 2000) realising the correct combination *Diderma peyerimhoffii* (Maire & Pinoy) H. Neubert, Nowotny & K. Baumann.

SINGER et al. (2001a) pointed out the similarity of this species with a *Lepidoderma*. POULAIN et al. (2002) finally consider it to be a *Lepidoderma*, because of its triple peridium being covered with lime scales typical for this genus.

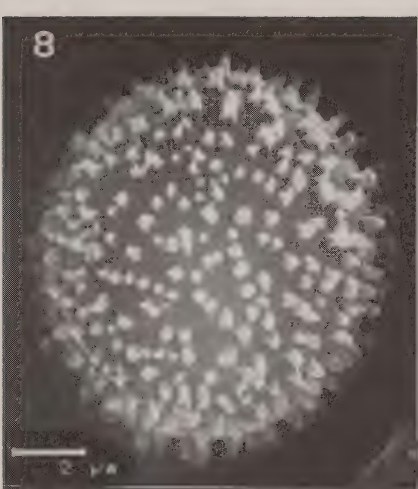
This species was cited from the Iberian Peninsula only from the province of Lérida (GRÀCIA, 1987) in nivicolous habitats.

***Physarum albescens* Ellis ex. T. Macbr.**, *N. Amer. Slime-Moulds*, ed. 2: 86. 1922. Figs. 8-9

Material examined. Sierra Nevada, Hoya de la Mora, 2,600 m, 10.V.2001, on *Cytisus oromediterraneus* Rivas Mart. et al., AH 29022, AH 29030, AH 29034, AH 29038, AH 29065, AH 29050, AH 29051 (with *Lamproderma maculatum*), AH 29098, AH 29153 (with *Physarum alpinum*), AH 29154; *ibidem*, 2,575 m, AH 29071 (with *Physarum vernum*); *ibidem*, 2,650 m, AH 29132; *ibidem*, 2,600 m, 11.V.2001, AH 29091, AH 29092, AH 29097, AH 29099, AH 29101, AH 29102, AH 19141, AH 29142, AH 29156; *ibidem*, 2,650 m, AH 29105, AH 29144; *ibidem*, 2,600 m, on *Festuca* sp., AH 29157; *ibidem*, on *Pinus uncinata* Ramond ex DC. in Lam. & DC., AH 29123; *ibidem*, 2,600 m, 26.VIII.2001, AH 29119, AH 30034; *ibidem*, Cauchiles, 2,700 m, on *Festuca* sp., AH 30035.

Description: Sporocarps loosely clustered to densely crowded, more or less conspicuously pedicellate or almost sessile, inverted pyriform to globose, rough, yellow, ochre-coloured to grey or white, without lime blue iridescent or brownish with a metallic shine, 0.8-1.2 mm. Hypothallus strongly developed, membranous, common to large groups, colourless, whitish, yellow, ochre-coloured to bright reddish, inconspicuously merging with the stipes. Stipe weak, strand-like, often membranously growing together with adjacent stipes, up to 2.5 mm, sometimes strongly reduced and arising as an extension of the hypothallus. Peridium double, the outer layer calcareous, rough, white or yellow outside, the inner side of the outer layer always yellow, the inner layer delicate, membranous, iridescent. Without columella. Capillitium densely ramified, protruding from the sporotheca, delicate, sometimes flattened, brownish, yellowish to hyaline, sometimes with fusiform thickenings, the nodes large, bright yellow, sometimes missing.

Figs. 8-9: *Physarum albescens* Ellis ex T. Macbr., (AH 30035). 16. Spore. 17. Detail of spore ornamentation. **Figs. 10-11:** *Physarum alpinum* (Lister & G. Lister) G. Lister, (AH 29153). 10. Spore. 11. Detail of spore ornamentation. **Figs. 12-13:** *Physarum vernum* Sommerf. in Fr., (AH 29117). 12. Spore. 13. Detail of spore ornamentation.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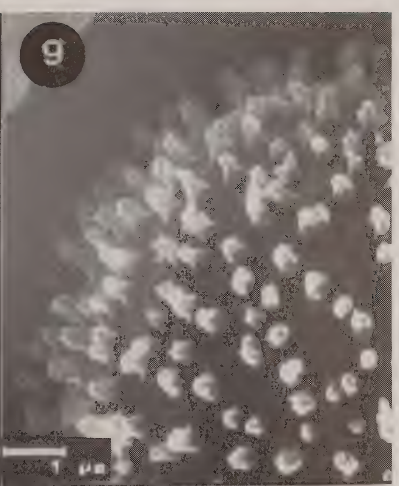
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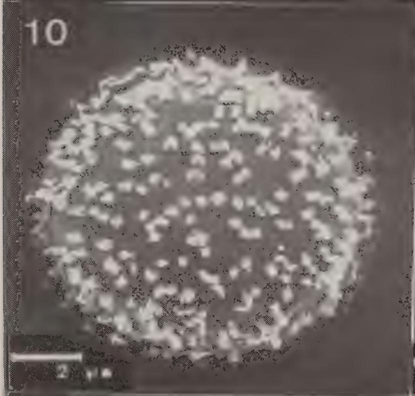
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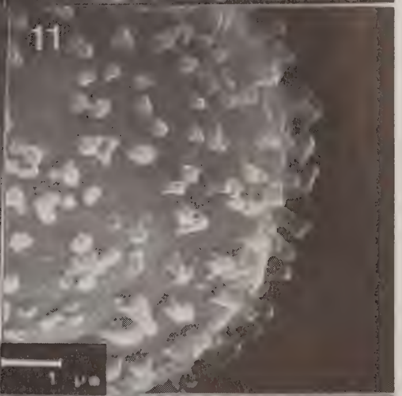
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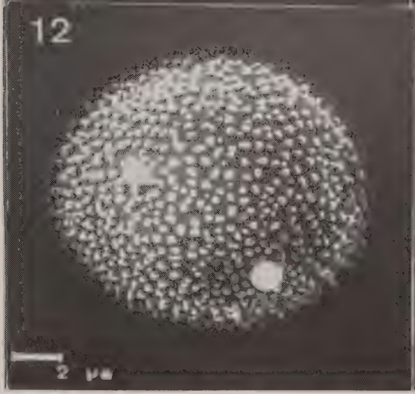
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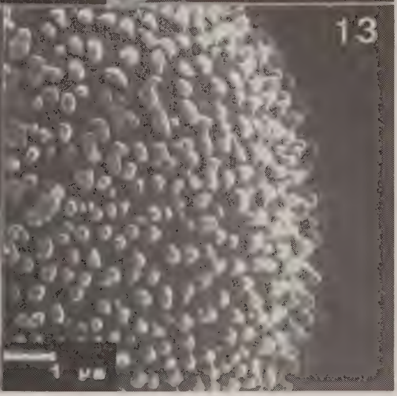
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Spores black in the mass, dark violaceous brown by transmitted light, distinctly warted, 12-13 µm in diam. With SEM the ornamentation consists of irregularly distributed baculae with irregular apices.

Remarks. *Physarum albescens* is characterised by its clustered to densely crowded sporocarps with a double peridium, the outer layer calcareous, rough, white or yellow, the inner side of the outer layer always being yellow, the dense capillitium protruding from the sporotheca - remotely resembling the elastic capillitium of an *Arcyria* - with prominent bright yellow nodes. This is a species frequently found in Sierra Nevada and the only Spanish record is from the mountains of Guadarrama, from the provinces of Madrid and Segovia (SÁNCHEZ et al., 1997, 2002).

The spore ornamentation observed with SEM in the material collected in the centre of Spain, Sierra de Guadarrama (SÁNCHEZ et al., 2002) and southern Spain, Sierra Nevada is identical.

***Physarum alpinum* (Lister & G. Lister) G. Lister**, *J. Bot.* 48: 73. 1910.

Figs. 10-11

Material examined. Sierra Nevada, Hoya de la Mora, 2,600 m, 11.V.2001, on *Festuca* sp., AH 29153 (with *Physarum albescens*).

Description: Sporocarps, crowded, sessile on a somewhat constricted base, subglobose to hemispheric, yellowish orange, yellow to yellowish brown, pulvinate, 0.5-1.5 mm in diam., 1 mm high, occasionally accompanied by short plasmodiocarps up to 2.5 mm long. Hypothallus membranous, colourless, inconspicuous when lime-less, frequently covered with white lime, confluent with adjacent hypothalli. Peridium double, the outer layer crustose, densely calcareous, flaking off irregularly, the inner layer membranous, sometimes iridescent. Capillitium dense, strongly calcareous, consisting of large, yellow, lime nodes and few very short, hyaline connecting filaments. Without columella. Spores brownish black in the mass, medium brown by transmitted light, (9-)10-11(-12) µm in diam., closely and evenly warted. With SEM the ornamentation consists of irregularly distributed baculae with irregular apices.

Remarks. *Physarum alpinum* is recognised by its yellow sporocarps or short plasmodiocarps, calcareous dense capillitium with large, yellow lime nodes and its spores generally 10-11 µm in diam.

This is a nivicolous species which presents the same ecology as *Physarum albescens* and can be distinguished from the latter by its capillitium which does not protrude from the sporotheca and by its smaller spores. *Physarum alpinum* is a new record for Spain.

***Physarum vernum* Sommerf.** in Fries, *Syst. Mycol.* 3: 146. 1829.

Figs. 12-13

Material examined. Sierra Nevada, Hoya de la Mora, 2,575 m, 10.V.2001, on *Cytisus oromediterraneus* Rivas Mart. et al., AH 29071 (with *Physarum albescens*), AH 29115; *ibidem*, 2,600 m, AH 29104, AH 29117, AH 29134, AH 29135, AH 29140; *ibidem*, 2,625 m, on herbaceous residues, AH 29066; *ibidem*, Hoya de la Mora, 2,575 m, 11.V.2001, on glass, AH 29146; *ibidem*, on *Cytisus oromediterraneus* Rivas Mart. et al., AH 29032, AH 29049, AH 29056, AH 29068, AH 29116; *ibidem*, 2,500 m, AH 29137 (with *Lamproderma ovoideum*); *ibidem,* 2,600 m, AH 29055, AH 29108; *ibidem*, on *Pinus uncinata* Ramond ex DC. in Lam. & DC., AH 29127.

Description: Plasmodiocarps elongate rounded, broadly spread, with constrictions and net-like depressions, deformed sporocarps, very crowded and merging to plasmodiocarps, up to 2 cm broad and several centimetres in extent, white to greyish white, sometimes limeless, brown to grey with a metallic shine. Hypothallus membranous, covered with white lime, common to large groups. Peridium single, membranous, covered with white lime, seldom lime-less and then with a metallic shine, or double, outer layer with densely compacted lime scales, smooth, seldom coarse and crumbling, inner layer membranous, long-persistent, covered with white lime, with irregular dehiscence. Without columella. Capillitium abundant, of large, angular, branching, limy nodes connected by short, hyaline tubules, the nodes sometimes concentrated in the centre to form a pseudocolumella. Spores dark brown in the mass, light purplish brown by transmitted light, warted, (10-)12-13(-14) µm in diam. With SEM an intermediate type of ornamentation between densely crowded warts and short baculae.

Remarks. *Physarum vernum* is easily recognised by its elongated rounded, broad whitish plasmodiocarps mixed with sporocarps, its peridium generally covered by densely compacted lime scales and abundant hyaline capillitium with extended limy nodes. With SEM, the material coincides in the spore ornamentation with the material collected in central Spain (SÁNCHEZ et al., 2002).

A close species is *Physarum albescens*, which has a double peridium with a yellow or white exoperidium, the inner side of the outer layer always being yellow. The capillitium of *P. albescens* has a somewhat elastic appearance and usually protrudes from the sporotheca.

Sometimes *Physarum vernum* lacks lime in the peridium and even in the calcareous nodes in the capillitium (AH 29032, AH 29049, AH 29056, AH 29066 and AH 29068) and may be confused with other genera of the Myxomycetes, for example *Diacheopsis*, but the members of this genus differ from *P. vernum* by its generally darker capillitium arising from the base.

According to LADO (1993) there are various non-nivicolous citations of this species of numerous Spanish provinces. These citations need to be confirmed in order to decide if *Physarum vernum* is not strictly nivicolous or to attach these citations to some other species of *Physarum*.

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TRICHIA SYNSPORA, A SYNONYM OF TRICHIA VARIA

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Abstract: The type of *Trichia synspora* has been found and re-examined applying electron microscopy techniques. The morphology of the sporocarps, spore ornamentation and capillitium are similar to *Trichia varia*, thus synonymy is proposed.

Key words: Myxomycetes, SEM, taxonomy, *Trichia*, Trichiales

INTRODUCTION

At the moment we are carrying out a revision of the nivicolous species of Myxomycetes proposed by Kowalski, who described 15 nivicolous species as new between the years 1966 and 1975. Among these, very common species can be found, such as *Lamproderma maculatum* and *Lepidoderma aggregatum*, but also rare species which have not been collected since and are known only from his collections from northern California, e.g. *Diderma brooksii* and *Diderma nigrum*. However, one species stands out which is known only at present from a single collection: *Trichia synspora*.

The specific epithet, which is compound of the Greek words συγ – together – and σησρος – seed–, makes reference to the clustered spores. This name is not uncommon in the Myxomycetes. There are other species including *Calomyxa synspora* M. L. Farr & Kowalski, *Diachea synspora* H. Z. Li., *Diacheopsis synspora* Nann.-Bremek. & Y. Yamam., *Didymium* *synsporon* H. W. Keller & T. E. Brooks, *Licea synsporos* Nann.-Brem., *Macbrideola synsporos* (Alexop.) Alexop. or *Physarum synsporum* S. L. Stephenson & Nann.-Bremek. Apart from having clustered spores, these species are each described only either from a single type collection or have been harvested from moist chambers. This would appear to indicate that this peculiar spore characteristic is due to irregular development caused by unfavourable environmental conditions, whether in the field or in the laboratory. Thus, we find it worthwhile to study this species thoroughly.

MATERIALS AND METHODS

The collected material was studied with a binocular microscope and, after mounting in Hoyer's medium, with a Nikon (Optiphot) microscope. Scanning electron microscopy (SEM) micrographs were taken in the University of Alcalá de Henares using a Zeiss DSM-950. SEM-preparation was made as indicated in MORENO et al. (2002).

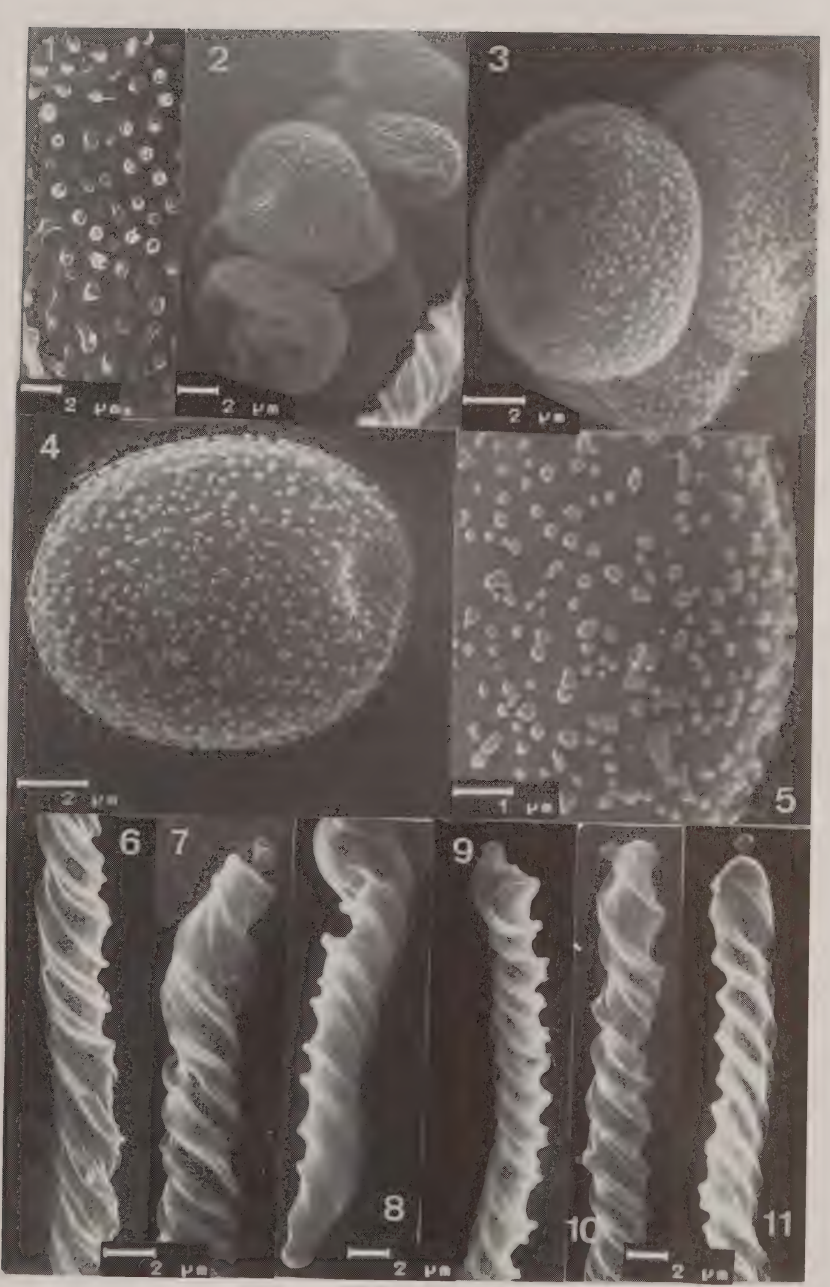
TAXONOMY

***Trichia synspora* Kowalski & McNichols** *in* Kowalski, *Mycologia* 66: 372. 1974. (as *"synsporum"*) Figs. 1-11

Material examined. *Trichia synspora*: USA, Washington, one mile below Hurricane Ridge, 5000 ft., Olympic National Park, on decayed coniferous log, 22.VI.1972, *leg.* D. T. Kowalski, D.T.K. 12547 (Type).

Trichia varia: Spain, Badajoz, Azuaga, Arroyo Argallón, on *Nerium oleander* L., 13.XII.1991, *leg.* J.R. García, AH 16194. Madrid, Montejo de la Sierra, on *Fagus sylvatica* L., 30.IV.1992, *leg.* A. Castillo & G. Moreno, AH 14811. Guadalajara, Atienza, on *Populus alba* L., 19.IV.1993, *leg.* A. Castillo, AH 16072, AH 16074. Mexico, Baja California, Las Chichiuas, Ensenada, on *Quercus agrifolia* Née, 5.V.1995, *leg.* M. Lizárraga, AH 17135. *Ibidem*, 1.II.1996, *leg.* M. Lizárraga, AH 20017, AH 20028, AH 20055, AH 20103, AH 20135. Austria, Innsbruck, near Hungerburg (868 m), on rotten stump beside snow, 4.IV.2000, *leg.* H. Singer, IB 2000/0248. *Ibidem*, on rotten conifer stump beside snow, IB 2000/0249. *Ibidem*, on twig beside snow, 14.IV.2000, IB 2000/0250. Stanzach (939 m), on dead trunk of *Betula* sp. beside snow, 25.IV.2000, *leg.* H. Singer, IB 2000/0251.

Figs. 1-11.- *Trichia synspora* (type). 1. Inner surface of the peridium. 2-3. Irregular spore clusters. 4. Spore. 5. Detail of spore ornamentation. 6. Detail of capillitial ornamentation. 7-11. Free ends of capillitium with ornamentation.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Description: The type material of *Trichia synspora* consists of two portions of heaped sporocarps, one on a piece of decayed coniferous wood, and the other on a small piece of woody residue, possibly of the same conifer. Sporocarps sessile, heaped, subglobose to globose, sometimes angular due to mutual pressure, 1-2 mm diam. Sporotheca light brown to beige, faintly shining. Hypothallus little developed, membranous, orange brown, shining, common to the whole fructification. Peridium single, membranous, thin, persistent, minutely faintly punctuate on the inner surface, translucent, light yellow by transmitted light; dehiscence irregular. Columella absent. Capillitium tubular, elastic, formed by elaters, light yellow by transmitted light; tubes 3-4 µm diam., flexuous, decorated with 2 smooth spiral bands, the free ends are blunt, rarely pointed. Spores rarely isolated, but generally in irregular clusters of two or three or frequently more, yellow in mass, light yellow by transmitted light, 10-12 µm, faintly warted. Under SEM the peridium shows in its inner surface baculate (Fig. 1), the spores form irregular clusters (Figs. 2, 3, 4), spore ornamentation consists of pila (Figs. 2-5), the free ends of the capillitium show variable morphology, some being pointed but the majority are blunt (Figs. 6-11).

DISCUSSION AND CONCLUSIONS

Trichia varia is one of the most common Myxomycetes which fructifies throughout the year, and can be found in the Alps at altitudes up to 1250 m (Neubert & al., 1993) and appears in the course of a succession of Myxomycetes as the snow retreats. Thus, if found near melting snow, one might tend to classify it at the first glance as a nivicolous species, until its study reveals its true identity. Kowalski did not put emphasis on its snow habitat and the clustered spores of *Trichia synspora* were considered enough to separate this species from *Trichia varia*, though he states, that – having elaters with two spiral bands – the two species may have a close phylogenetic relationship. Nevertheless, he believed it more closely related to *T. macbridei* Peck, a non-nivicolous species, with a certain similarity but differing in such an important character as the capillitium, consisting of elaters with three to four spiral bands.

It is generally known that nivicolous species have very variable morphological characters, especially with regard to both the ornamentation and the size of the spores. In early studies of nivicolous Myxomycetes these differences gave rise to the proposal of new varieties, such as macrosporic varieties. Nowadays, these differences are accepted by many investigators to be of no taxonomic value - ourselves included - to represent simple variations resulting from the harsh environmental conditions, which at high altitudes and near the snow require rapid fructification.

The spores of *Trichia synspora* are clustered in irregular groups and generally collapsed, which indicates us an aberrant fructification. Even if we apply critical point drying techniques for electron microscopy, the clusters appear generally collapsed. The capillitium, although its ornamentation is well formed, the tips are very irregular, confirming its poor fructification. If we compare with previous SEM studies of *Trichia varia* made by other authors (RAMMELOO, 1974, NEUBERT & al., 1993, LIZARRAGA & al. 1999; MORENO & al, 2001), there is a very similar ornamentation on the inner side of the peridium, the capillitium and the spores.

Therefore, we conclude that *Trichia synspora* is the typical example of an irregular fructification due to unfavourable environmental conditions, and we synonymise it with *T. varia*, with which it coincides completely.

Our taxonomic proposal is as follows:

***Trichia varia* (Pers. ex J. F. Gmel.) Pers.**, *Neues Mag. Bot.* 1: 90. 1794.
= *Trichia synspora "synsporum"* Kowalski & McNichols *in* Kowalski, *Mycologia* 66(2): 372. 1974.

ACKNOWLEDGEMENTS

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MYCOTAXON

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A NEW RECORD OF COSMOSPORA EPISPHAERIA HYPERPARASITIC ON HYPOXYLON SPECIES FROM AMERICAN BEECH

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ABSTRACT

This is a first report of *Cosmospora episphaeria* (Ascomycetes: Hypocreaceae) (anamorph: *Fusarium aquaeductuum* var. *medium*) hyperparasitic on *Hypoxylon* spp. (Ascomycetes: Xylariales) from *Fagus grandifolia*. Its hyperparasitic relationship is documented and illustrated.

Keywords : Ascomycota, biological control, mycoparasite, *Hypoxylon*, *Fagus grandifolia*

INTRODUCTION

Fungi in the genus *Hypoxylon* (Ascomycota, Xylariaceae) are known to cause serious bark cankers and a white rot of hardwood (Sinclair et al. 1996) and some cankering caused by these fungi contributes to the premature death of trees (Myren et al. 1994). Some species seem to be restricted to higher latitudes of the northern hemisphere (Ju and Rogers 1996) and *Hypoxylon cohaerens* (Pers. : Fr.) Fr., *H. deustum* (Hoffm. : Fr.) Grev. (=*Ustulina*), *H. fragiforme* (Scop. : Fr.) J. Kickx fil., *H. mammatum* (Wahl.) P. Karst. (=*Entoleuca*) and *H. rubiginosum* (Pers. : Fr.) Fr. have been reported on American beech (*Fagus grandifolia* Ehrh.) in Canada (Ginns 1986, Vujanovic 2001).

A recent biodiversity study on mycobiota on American beech in Quebec, Canada, revealed a new relationship between hyperparasitic *Cosmospora episphaeria* (Tode) Rossman & Samuels and *Hypoxylon cohaerens*, *H. fragiforme* and *H. rubiginosum* (Ascomycetes: Xylariales). *C. episphaeria* is a member of the Hypocreales, an order of ascomycetous microfungi, containing the families Hypocreaceae, Bionectriaceae and Nectriaceae. Studies by Booth (1959) and Rossman et al. (1999) allowed us to compare this species with similar species in the genera *Cosmospora* and *Nectria* and other taxa of the Nectriaceae.

This fungus has never previously been reported from Quebec (SPPQ, 1996) nor from other provinces of Canada except Ontario and Manitoba (Ginns 1986). It was reported as a mycoparasite on wood-inhabiting Ascomycetes and as a saprobe on different vascular plants (*Acer, Alnus, Betula, Carpinus, Corylus, Gleditsia, Fagus, Lithocarpus, Lupinus, Pinus,* *Quercus* and *Sambucus*) in North America (Ginns 1986, Farr et al, 1989). Although it seems that various pyrenomycetous fungi could be attacked by this fungus (Booth 1959; Dennis 1977; Ellis and Ellis 1985), little is known about specific fungal/host partners. To our knowledge, the only two fungus-fungus specimens from North America are kept in the NYBG (449544) collection as *C. episphaeria* on *Valsa* sp. (Ascomycota, Diaporthales) and in the BPI (746715) herbarium as *C. episphaeria* on *Diatripe stigma* (Ascomycota, Xylariales) (S. Huhndorf, personal communication). Recently, this fungus has been reported to be commonly associated with *Hypoxylon truncatum* (Schw. ex Fr.) J.H. Miller. in Japan (Tsuneda 1982). To the best of our knowledge, this is the first report of *C. episphaeria* present on *Hypoxylon* from American beech, and it is the first record of such parasitism in North America (Farr et al. 1989).

MATERIAL AND METHODS

Materials in this study were collected from the Muir's Wood ecological reserve, an American beech (*Fagus grandifolia.*) old-growth forest in Quebec, Canada (Vujanovic 2001). A more complete description of the geographic location and the myco- and plant communities of the Muir's Wood can be found in Vujanovic (2002a, 2002b). Small pieces of bark (~ 1 cm^2) were collected from cankered tissues bearing the *Hypoxylon* stromata at different locations on the tree trunk (10 samples/host). The study was carried out two times in the middle of September and October 1998. The samples were collected with a sterile scalpel and kept in sterile boxes or bags labeled with the date of sampling and the location in the forest. Specimens were examined by light microscope, during 24h of sampling, and deposited in the herbarium of the Institute (accession number: MT-NE03).

RESULTS AND DISSCUTION

Semiglobose ascostromata of three *Hypoxylon* species : *H. cohaerens*, *H. fragiforme* and *H. rubiginosum* were often found in the center or in the peripheral region of the bark canker on American beech trees. The *Hypoxylon* stromata parasitization by *Cosmospora episphaeria* was common in all hosts (~ 80%) and was initiated during the first stage of host-stromata development. In this stage the *Fusarium* anamorph (*F. aquaeductuum* (Radlk. & Rabenh.) Lagerh. var. *medium* Wollenw.) of *C. episphaeria* became abundant completely covering the host stromata with a white-orange mycelium. The destruction of the host-tissues and the development of mycoparasite's ascomata appears to proceed in a synchronized manner with host-tissue maturity. Frequently, over 40 ascomata of *Cosmospora* were counted per single mature *Hypoxylon* stroma.

Cosmospora episphaeria (Tode) Rossman & Samuels FIGURES 1-8

Perithecial ascomata erumpent, scattered to aggregated, globose to ovate, laterally collapsing when dried, bright red, 150-250 µm, with ostiolar papilla, and bearing an apical disc 30-50 µm surrounded with hyaline to light-brown setae-like hyphae 10-15 x 2-3 µm; lateral wall 20-40 µm with an inner wall composed of 3-4 layers of hyaline thin-walled cells lining perithecial cavity, 15-25 µm.

Asci cylindrical to clavate, with an apical ring, 50-75 x 4.5-6.5 µm.

Ascospores bicellullar, uniseriate, eight per ascus, oblong to ellipsoid, light brown, constricted at the central septum, verrucose, 5.0-7.5 x 3.5-4.5 µm.

Anamorph is *F. aquaeductuum* var. *medium* with cylindrical macroconidia 0-5 septate having subulate apex; 0-3 septate conidia measure 20-35 x 3 µm and 4-5 septate 40-55 x 3 µm.

SPECIMENS EXAMINED: CANADA, Quebec, Muir's Wood ecological reserve, on living stroma of *Hypoxylon* spp, from bark of *Fagus grandifolia*. 12. IX. 1998, Vujanovic MT-NE03 (MT).

In conclusion, the morphological characteristics of our specimens agree with those of *Cosmospora episphaeria* described by Booth (1959), Dennis (1977) and Tsuneda (1982). In the ecological conditions of the Province of Québec, Canada, *C. episphaeria* grows well on stromata of various *Hypoxylon* species. Stromata may at the same time bear fully developed ascomata of both *Cosmospora* and *Hypoxylon*. Usually, *Cosmospora* ascomata were observed over the ostiola of the host stroma. *Hypoxylon* stromata that are infected in the initial stage of development often bear the imperfect *Fusarium* stage of *C. episphaeria*. In this case, the host stromata that are commonly seen are completely destroyed. This nature of *C. episphaeria* could be described as hyperparasitic. Tsuneda (1982) also reported the fungus's mycoparasitic behavior against *H. truncatum in vitro,* thus decreasing substantially the host's inoculum potential. It seems that *Cosmospora episphaeria* could be potentially useful in biological control of various *Hypoxylon* taxa. The facility to produce inoculum of *C. episphaeria* (anamorph: *Fusarium*) in agar culture (potato dextrose-agar) supports our hypothesis of a high biocontrol potential of this fungus.

ACKNOWLEDGEMENTS

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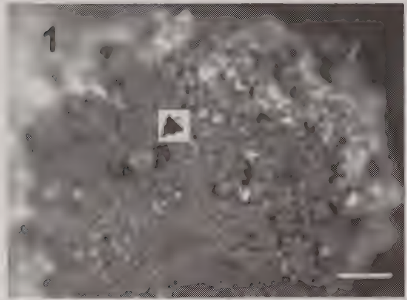
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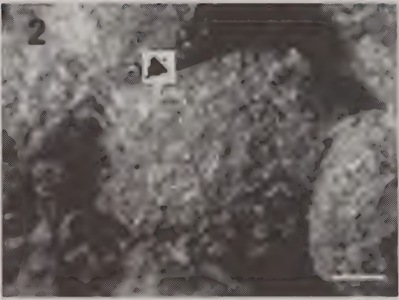
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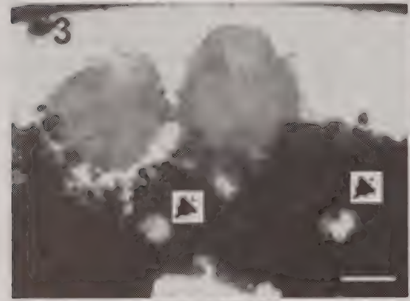
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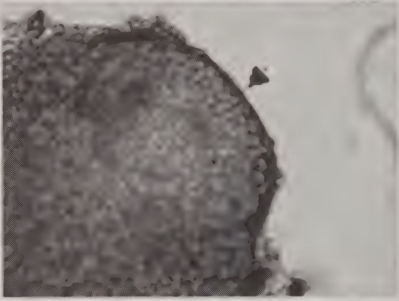
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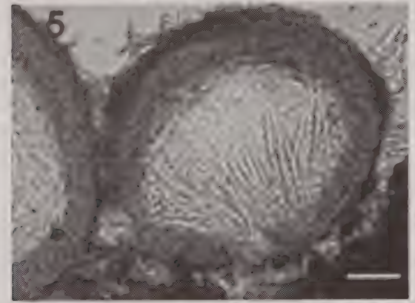
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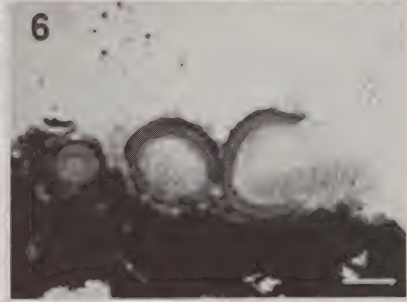
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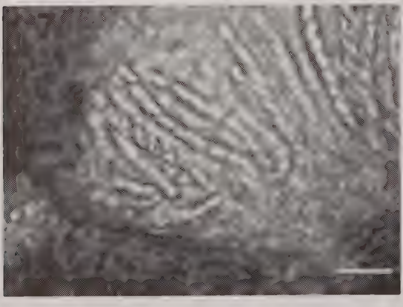
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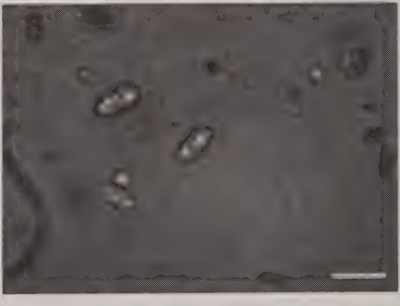
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Figures 1-8. *Cosmospora episphaeria* (Tode) Rossman & Samuels on *Hypoxylon cohaerens* from *Fagus grandifolia* (MT-NE03) : 1. *Nectria* ascoma (arrow) on fully necrotic stroma of *Hypoxylon* (bar = 250 µm); 2. Ascomata of *Cosmospora* with white invasive mycelium of *Fusarium* anamorph (arrow) on host mature ascostromata (bar = 500 µm); 3. *Cosmospora* ascomata on surface of host' stroma completly destroying ascomata (note: arrows indicate the empty host' ascomata (bar = 100 µm); 4. *Cosmospora* ascoma with an apical disc (arrow) bearing a central ostiole (bar = 10 µm); 5. Enlarged view of *Cosmospora* ascomata transversal section (bar = 25 µm); 6. Different maturity stages of *Cosmospora* ascomata showing intra-stromatal development (arrow) rupturing the host peripheral wall (bar = 50 µm); 7. Asci of *Cosmospora* with eight uniseriate ascospores (bar = 10 µm); 8. *Cosmospora* bicellular ascospores (bar 10 µm).

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PRELIMINARY CHECKLIST OF AGARICALES FROM CROATIA III: FAMILIES BOLETACEAE, GOMPHIDIACEAE AND PAXILLACEAE

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ABSTRACT

The third part of the preliminary checklist of Agaricales from Croatia is given. It comprises the families Boletaceae, Gomphidiaceae and Paxillaceae. 85 species belonging to 19 genera are presented. Six species are reported for the first time from Croatia. For each species, the published and unpublished sources of data are given, as well as the collections in which the material is deposited. The new combination *Paxillus panuoides* var. *ionipus* is proposed.

Key words: Basidiomycota, biodiversity, mycoflora, bibliography

INTRODUCTION

This is the third part of the preliminary checklist of Agaricales from Croatia. The first two parts have been published in Mycotaxon (Tkalčec & Mešić 2002, Mešić & Tkalčec 2002). This part comprises the families Boletaceae, Gomphidiaceae and Paxillaceae. The checklist includes data published or collected before 1 January 2000. Information about the geographical and biogeographical position of Croatia, material, methods and presentation are given in Tkalčec & Mešić (2002).

In this paper we present 85 species belonging to 19 genera found on the territory of Croatia, of which we have revised 64 species. Out of the overall number 74 species belong to the family Boletaceae, five species to the family Gomphidiaceae, and six species to the family Paxillaceae. Six species are reported for the first time from Croatia.

Marks and abbreviations:

* - taxon reported for the first time from Croatia in this paper;
• - at least part of records of taxon revised;
(1) - number in brackets indicates synonym or misapplied name under which the author of the record has quoted the taxon;
( ) - empty brackets indicate that the author of the record has also quoted the taxon under the name we use;
? - (a) question mark instead of an author of combination means that we could not find the author in the literature available to us; (b) question mark following the source of a published record or abbreviation of a collection means that the author himself doubted his original identification;
= **?** - taxon not found in modern taxonomic literature;
Exs. - collections in which the dried material (exsiccatum) is deposited;
HR? - taxon most probably found in the territory of Croatia (locality not precisely quoted);
Incl. - including;
Lit. - literature;
Misappl. - misapplied name;
Ref. - references (sources of records of taxon);
rev. - revised (when we have revised records of other authors or species for synonymy);
unp. - unpublished data.

SURVEY OF TAXA

Family **Boletaceae** Cheval.

Aureoboletus Pouzar

(Lit.: Alessio 1985, Arnolds *& al.* 1995, Both 1993, Galli 1998, Hansen & Knudsen 1992, Kreisel 1987, Lannoy & Estades 2001, Pilát & Dermek 1974, Singer 1966, Singer 1986)

•***Aureoboletus gentilis*** (Quél.) Pouzar
= *Pulveroboletus gentilis* (Quél.) Singer
= *Pulveroboletus cramesinus* (Secr. ex J.-E. Gilbert) Moser
= *Xerocomus cramesinus* Secr. ex J.-E. Gilbert (1)
Misappl.: *Xerocomus auriporus* (Peck) Singer sensu Kallenb. non Peck (2)
Ref.: Focht 1972 (1), Tortić 1968 b (1), unp. Tkalčec & Mešić, unp. Tortić (2)

Exs.: CNF
(Lit.: Alessio 1985, Lannoy & Estades 2001, Pilát & Dermek 1974)

Boletinus **Kalchbr.**

(Lit.: Alessio 1985, Arnolds *& al.* 1995, Engel *& al.* 1996, Galli 1998, Hansen & Knudsen 1992, Kreisel 1987, Lannoy & Estades 2001, Moser 1983, Pilát & Dermek 1974, Redeuilh & Simonini 1998, Singer 1964, Singer 1986)

•***Boletinus cavipes*** (Klotzsch ex Fr.) Kalchbr.
Ref.: Focht 1987, unp. Tkalčec & Mešić
Exs.: CNF
(Lit.: Alessio 1985, Engel *& al.* 1996, Pilát & Dermek 1974)

Boletus **Dill. ex L. : Fr.**

(Lit.: Alessio 1985, Alessio 1991, Arnolds *& al.* 1995, Bollmann *& al.* 1996, Engel *& al.* 1983, Galli 1998, Hansen & Knudsen 1992, Kreisel 1987, Lannoy & Estades 2001, Martin 1903, Merlo *& al.* 1983, Moser 1983, Pilát & Dermek 1974, Rauschert 1987, Singer 1966, Singer 1977, Singer 1986, Singer & Kuthan 1976 a, Watling 1970)

•***Boletus aereus*** Bull. : Fr.
- as *Boletus edulis* Bull. : Fr. var. *fuscoruber* (Forq.) Bataille sensu Moser (1)

Ref.: Božac 1984 (rev.) (1), Božac 1986 (rev.) (1), Božac 1989 (rev.) (1), Božac 1993 (rev.) (1), Focht 1979, Focht 1981 a, Focht 1986, Focht 1987, Kranjčev 1995, Mužic & Božac 1997 (rev.) (1), Tortić 1968 b, unp. Matočec, unp. Tkalčec & Mešić, unp. Tortić
Exs.: CNF
(Lit.: Alessio 1985, Engel *& al.* 1983, Pilát & Dermek 1974)

•***Boletus aestivalis*** (Paulet) ex Fr.
Misappl.: *Boletus reticulatus* Schaeff. sensu auct. non Schaeff. (1)
Misappl.: *Boletus edulis* Bull. : Fr. subsp. *reticulatus* (Schaeff.) Konrad et Maubl. sensu auct. non Schaeff. (2)
Ref.: Focht 1979 (1), Focht 1981 a (2), Focht 1987), Kranjčev 1995 ( )(1), unp. Matočec (1), unp. Tkalčec & Mešić, Schulzer 1857 HR? (1)
Exs.: CNF
(Lit.: Engel *& al.* 1983, Galli 1998, Pilát & Dermek 1974)

•***Boletus appendiculatus*** Schaeff.
Ref.: Focht 1979, Focht 1987, Kallenbach 1926-1942, Kranjčev 1995, Tortić 1964, Tortić 1966 a, Tortić 1966 b, Tortić & Lisiewska 1978, unp. Lisiewska, unp. Matočec, unp. Tkalčec & Mešić, unp. Tortić, Schulzer 1857 HR?

Exs.: CNF, POZM
(Lit.: Engel *& al.* 1983, Galli 1998, Lannoy & Estades 2001)

Boletus betulicola (Vassilkov) Pilát et Dermek
Ref.: Focht 1987, Kranjčev 1995
Exs.: CNF

•***Boletus calopus*** Pers. : Fr.
= *Boletus pachypus* Fr. : Fr. (1)
Ref.: Focht 1986 (1), Focht 1987, Lorinser - Janda 1877 ( )(1), Tortić 1964, Tortić 1966 a, Tortić 1966 b, Tortić & Lisiewska 1978, Vouk & Pevalek 1916 ( )(1), unp. Matočec, unp. Tkalčec & Mešić, unp. Tortić ( )(1)
Exs.: CNF
(Lit.: Galli 1998, Pilát & Dermek 1974, Singer 1966)

Boletus caucasicus Singer ex Alessio
Ref.: Focht 1987, Focht 1984 HR?, Focht 1986 HR?

*•***Boletus depilatus*** Redeuilh
- as *Boletus impolitus* Fr. (1)
Ref.: unp. Tkalčec & Mešić, unp. Tortić (rev.) (1)
Exs.: CNF
(Lit.: Galli 1998, Redeuilh 1985)

•***Boletus dupainii*** Boud.
Ref.: Focht 1974, Focht 1979, Focht 1987, Vrščaj 1990, unp. Tkalčec & Mešić, Focht 1984 HR?, Focht 1986 HR?
Exs.: CNF
(Lit.: Engel *& al.* 1983, Galli 1998, Pilát & Dermek 1974)

•***Boletus edulis*** Bull. : Fr.
= *Boletus bulbosus* Schaeff. (1)
Ref.: Blagaić 1921, Blagaić 1931 a, Focht 1979, Forenbacher 1915 (1), Frković 1998, Gjurašin 1898, Kranjčev 1979, Kranjčev 1995, Lorinser - Janda 1877, Moesz 1938 (1), Schulzer *& al.* 1866, Škorić 1928 (1), Tortić 1964, Tortić 1966 a, Tortić 1966 b, Tortić 1968 a, Tortić & Lisiewska 1978, Vouk & Pevalek 1916 (1), unp. Matočec, unp. Tkalčec & Mešić, unp. Tortić, Schulzer 1857 HR?
Exs.: CNF
(Lit.: Engel *& al.* 1983, Galli 1998, Pilát & Dermek 1974)

Boletus edulis Bull. : Fr. **sensu lato**
Ref.: Tortić 1993, Tortić 1994

•***Boletus fechtneri*** Velen.
Misappl.: *Boletus aestivalis* (Paulet) ex Fr. sensu Kallenb. non Fr. (1)
Ref.: Focht 1979, Kallenbach 1926-1942 (1), Tortić 1966 a, Tortić 1966 b, Vrščaj 1990, unp. Matočec, unp. Tkalčec & Mešić, unp. Tortić
Exs.: CNF
(Lit.: Alessio 1985, Engel *& al.* 1983, Pilát & Dermek 1974)

•**Boletus fragrans** Vittad.
Ref.: Vouk & Pevalek 1916, unp. Tkalčec & Mešić
Exs.: CNF
(Lit.: Galli 1998, Merlo *& al.* 1983)

•**Boletus impolitus** Fr.
= *Boletus validus* C. Martin (rev.) (1)
Ref.: Božac 1984, Božac 1986, Božac 1989, Božac 1993, Focht 1987, Tortić 1968 b (rev.), Vouk & Pevalek 1916 ( )(1), unp. Tkalčec & Mešić, unp. Tortić (rev.)
Exs.: CNF
(Lit.: Galli 1998, Redeuilh 1985)

Boletus junquilleus (Quél.) Costantin et L.M. Dufour
= *Boletus luridiformis* Rostk. var. *junquilleus* (Quél.) Knudsen
Ref.: Focht 1974

•**Boletus legaliae** (Pilát) Pilát et Ušák
= *Boletus rubrosanguineus* (Walty) ex Cheype (1)
= *Boletus splendidus* C. Martin subsp. *moseri* Singer et Kuthan (2)
Misappl.: *Boletus satanoides* Smotl. sensu auct. non Smotl. (3)
Misappl.: *Boletus splendidus* C. Martin sensu auct. non C. Martin (4)
Misappl.: *Boletus splendidus* C. Martin subsp. *splendidus* sensu auct. non C. Martin (5)
Ref.: Božac 1982 (3), Božac 1984 (3), Focht 1984 (2), Focht 1986 (2), Focht 1987 (2), unp. Lisiewska (5), unp. Passauer (according to Voglmayr) (1), unp. Tkalčec & Mešić, Blagaić 1923 ? (4)
Exs.: CNF, POZM (5), WU (1)
(Lit.: Galli 1998, Lannoy & Estades 2001)

Boletus lupinus Fr. (sensu Romagn.)
Ref.: Focht 1974, Focht 1979, Focht 1984, Focht 1986, Focht 1987, Vrščaj 1990
Exs.: CNF

•**Boletus luridiformis** Rostk.
= *Boletus erythropus* Pers. var. *vetustus* (Killerm) ? (1)
= *Boletus erythropus* Pers. f. *vetustus* Killerm. (2)
= *Boletus miniatoporus* Secr. (nom. inval.) (3)
Misappl.: *Boletus erythropus* Pers. sensu auct. non Pers. (4)
(sensu Pers. = *B. queletii* Schulzer)
Ref.: Blagaić 1931 a (3), Focht 1974 (1)(4), Focht 1979 (2)(4), Focht 1986 (4), Focht 1987 (4), Kallenbach 1926-1942 (3), Kranjčev 1995 (4), Tortić 1964 (4), Tortić 1966 a (4), Tortić 1966 b (4), Tortić 1994 (4), unp. Matočec (4), unp. Tkalčec & Mešić, unp. Tortić (4), Focht 1987 HR? (2)
Exs.: CNF
(Lit.: Engel *& al.* 1983, Galli 1998, Pilát & Dermek 1974)

•***Boletus luridus*** Schaeff. : Fr.

Ref.: Barčić 1982, Barčić 1996, Blagaić 1931 a, Božac 1982, Božac 1984, Božac 1986, Božac 1989, Božac 1993, Focht 1974, Forenbacher 1915, Gjurašin 1898, Kallenbach 1926-1942, Kranjčev 1995, Lisiewska & Tortić 1990, Lorinser - Janda 1877, Mužic & Božac 1984, Mužic & Božac 1997, Schulzer 1882, Schulzer *& al.* 1866, Škorić 1928, Tortić 1964, Tortić 1966 a, Tortić 1966 b, Tortić 1993, Tortić 1994, Vouk & Pevalek 1916, unp. Matočec, unp. Tortić, Focht 1979 HR?, Schulzer 1857 HR?
Exs.: CNF

•var. ***luridus***
Ref.: unp. Tkalčec & Mešić
Exs.: CNF
(Lit.: Engel *& al.* 1983, Pilát & Dermek 1974)

var. ***erythroteron*** (Bezděk) Pilát et Dermek
Ref.: Focht 1984, Focht 1986, Focht 1987, unp. Passauer (according to Voglmayr)
Exs.: WU

•***Boletus pinophilus*** Pilát et Dermek

= *Boletus pinicola* (Vittad.) A. Venturi (comb. illeg.) non *B. pinicola* Sw. : Fr. (1)
= *Boletus edulis* Bull. : Fr. subsp. *pinicola* (Vittad.) Konrad et Maubl. (2)
Ref.: Božac 1982 (2), Božac 1984 (1), Božac 1986 (1), Božac 1989 (1), Božac 1993 (1), Focht 1979 (1), Focht 1987, Kranjčev 1995 (1), unp. Matočec, unp. Tkalčec & Mešić
Exs.: CNF
(Lit.: Alessio 1985, Engel *& al.* 1983, Pilát & Dermek 1974)

•***Boletus pulverulentus*** Opat.

Ref.: Focht 1974, unp. Lisiewska, unp. Tkalčec & Mešić, unp. Tortić
Exs.: CNF, POZM
(Lit.: Alessio 1985, Engel *& al.* 1983, Pilát & Dermek 1974)

•***Boletus queletii*** Schulzer

= *Boletus queletii* Schulzer f. *rubicundus* (Maire) ? (1)
= *Boletus queletii* Schulzer var. *squarrosipes* Schulzer (2)
= *Boletus bresadolae* Schulzer (3)
= *Boletus erythropus* Pers. (sensu Pers. non sensu auct.) (4)
= *Boletus lateritius* Bres. et Schulzer (5)
= *Boletus rutilus* Fr. var. *queletii* Schulzer (rev.) (6)
= *Boletus rutilus* Fr. var. *schulzeri* Quél. (rev.) (7)
= *Boletus slavonicus* Sacc. et Cub. (8)

Ref.: Barčić 1982, Barčić 1996, Blagaić 1931 a (4), Focht 1974, Focht 1979, Focht 1984, Focht 1986 ( )(1), Focht 1987 ( )(1), Kallenbach 1926-1942 (4), Mužic & Božac 1984, Mužic & Božac 1997, Saccardo 1888 a ( )(2)(5)(6)(7)(8), Schulzer 1885 ( )(2)(3)(5)(6)(7), Singer 1966, Tortić 1964, Tortić & Lisiewska 1978, Vrščaj 1990, unp. Lisiewska, unp. Matočec, unp. Tkalčec & Mešić, unp. Tortić
Exs.: CNF, POZM
(Lit.: Engel *& al.* 1983, Galli 1998, Pilát & Dermek 1974)
Annotation: Persoon described this species in 1796 under the name *Boletus erythropus*. Since Fries (1821), most authors have misapplied this name to *B. luridiformis* Rostk. Fries (1821) sanctioned this epithet at the rank of variety. Although the legitimate name for this species is *B. erythropus* Pers., we do not use it because the application of this name in the original sense would cause a disadvantageous nomenclatural change. We consider that name *B. erythropus* should be proposed for rejection (ICBN 2000, article 56.).

•***Boletus radicans*** Pers. : Fr.
= *Boletus amarus* Pers. (1)
= *Boletus conglobatus* Blagaić (2)
Misappl.: *Boletus albidus* Roques sensu auct. non Roques (3)
Ref.: Blagaić 1919 (2), Božac 1982 (3), Božac 1984 (3), Božac 1986 (3), Božac 1989 (3), Božac 1993 (3), Focht 1979 (3), Focht 1984 (3), Focht 1986 (3), Focht 1987 (3), Kallenbach 1926-1942, Tortić 1964, Tortić 1966 a, Vouk & Pevalek 1916, unp. Tkalčec & Mešić, unp. Tortić (1)
Exs.: CNF
(Lit.: Alessio 1985, Galli 1998, Pilát & Dermek 1974)

•***Boletus regius*** Krombh.
Ref.: Barčić 1982, Barčić 1984, Barčić 1996, Blagaić 1923, Blagaić 1931 a, Focht 1979, Focht 1984, Focht 1986, Focht 1987, Kallenbach 1926-1942, Kranjčev 1995, Tortić 1968 b, Tortić & Lisiewska 1978, unp. Tkalčec & Mešić, unp. Tortić
Exs.: CNF
(Lit.: Engel *& al.* 1983, Pilát & Dermek 1974)

Boletus rhodopurpureus Smotl.
Ref.: Focht 1987, Focht 1984 HR?, Focht 1986 HR?

•***Boletus rhodoxanthus*** (Krombh.) Kallenb.
= *Boletus purpureus* Pers. var. *rhodoxanthus* (Krombh.) Moser (comb. inval.) (1)
Ref.: Blagaić 1931 a, Focht 1974, Focht 1984, Focht 1986, Tortić 1964 (1), Tortić 1993, Tortić & Lisiewska 1978, unp. Lindtner, unp. Tkalčec & Mešić, unp. Tortić ( )(1)
Exs.: BEO, CNF
(Lit.: Engel *& al.* 1983, Galli 1998, Pilát & Dermek 1974)

•***Boletus satanas*** Lenz

Ref.: Barčić 1984, Barčić 1989, Barčić 1996, Blagaić 1931 a, Božac 1982, Božac 1984, Božac 1986, Božac 1989, Božac 1993, Focht 1974, Focht 1979, Focht 1984, Focht 1986, Focht 1987, Forenbacher 1915, Gjurašin 1898, Kallenbach 1926-1942, Lorinser - Janda 1877, Mužic & Božac 1997, Škorić 1928, Tortić 1964, Vouk & Pevalek 1915, unp. Tkalčec & Mešić, unp. Tortić, Schulzer 1857 HR?
Exs.: CNF
(Lit.: Alessio 1985, Galli 1998, Engel *& al.* 1983)

Boletus separans Peck

Ref.: Focht 1984, Focht 1986, Focht 1987

•***Boletus speciosus*** Frost

= *Boletus pseudoregius* (H. Huber) ex Estades
= *Boletus appendiculatus* Schaeff. var. *pseudoregius* H. Huber (nom. inval.) (1)
Ref.: Focht 1974, Focht 1979 (1), Focht 1984, Focht 1986, Focht 1987, Vrščaj 1990, unp. Tkalčec & Mešić
Exs.. CNF
(Lit.: Engel *& al.* 1983, Galli 1998, Pilát & Dermek 1974)
Annotation: Some modern authors consider that North American records of this species are different from European, and that European records represent different species, *Boletus pseudoregius*.

Boletus torosus Fr.

Ref.: Focht 1974, Focht 1984, Focht 1986, Focht 1987
Exs.: CNF

Chalciporus Bataille

(Lit.: Alessio 1985, Arnolds *& al.* 1995, Galli 1998, Hansen & Knudsen 1992, Lannoy & Estades 2001, Moser 1983, Pilát & Dermek 1974, Singer 1964, Singer 1986, Watling 1970)

•***Chalciporus piperatus*** (Bull. : Fr.) Bataille

= *Boletus piperatus* Bull. : Fr. (1)
= *Suillus piperatus* (Bull. : Fr.) Kuntze (2)
= *Boletus acris* Schulzer (rev.) (3)
Ref.: Focht 1987, Kranjčev 1995, Schulzer 1880 a (3), Tortić 1964 (2), Tortić 1966 a (2), Tortić 1966 b (2), Tortić & Lisiewska 1978 (2), unp. Tkalčec & Mešić, unp. Tortić (1)(2)
Exs.: CNF
(Lit.: Galli 1998, Moser 1983)

*•***Chalciporus rubinus*** (W.G. Sm.) Singer

Ref.: unp. Tkalčec & Mešić
Exs.: CNF
(Lit.: Galli 1998, Moser 1983)

Gyrodon Opat.

(Lit.: Alessio 1985, Arnolds *& al.* 1995, Bollmann *& al.* 1996, Galli 1998, Hansen & Knudsen 1992, Kreisel 1987, Lannoy & Estades 2001, Moser 1983, Pilát & Dermek 1974, Singer 1964, Singer 1986)

•***Gyrodon lividus*** (Bull. : Fr.) P. Karst.
= *Boletus lividus* Bull. : Fr. (1)
Ref.: Focht 1987, Kranjčev 1995, Mužic & Božac 1997, Škorić 1928 (1), Tortić 1964, unp. Tkalčec & Mešić, unp. Tortić
Exs.: CNF
(Lit.: Alessio 1985, Moser 1983, Pilát & Dermek 1974)

Gyroporus Quél.

(Lit.: Alessio 1985, Arnolds *& al.* 1995, Galli 1998, Hansen & Knudsen 1992, Kreisel 1987, Lannoy & Estades 2001, Moser 1983, Pilát & Dermek 1974, Singer 1964, Singer 1986)

•***Gyroporus castaneus*** (Bull. : Fr.) Quél.
= *Boletus castaneus* Bull. : Fr. (1)
Ref.: Barčić 1982, Barčić 1996, Focht 1974, Focht 1984, Focht 1986, Focht 1987, Kranjčev 1995, Lange 1974, Schulzer *& al.* 1866 (1), Tortić 1964, Tortić 1966 a, Tortić 1966 b, Tortić 1968 b, unp. Matočec, unp. Tkalčec & Mešić, unp. Tortić, Schulzer 1857 HR? (1)
Exs.: BEO, CNF
(Lit.: Galli 1998, Lannoy & Estades 2001, Pilát & Dermek 1974)

•***Gyroporus cyanescens*** (Bull. : Fr.) Quél.
= *Gyroporus cyanescens* (Bull. : Fr.) Quél. var. *lacteus* (Lév.) Quél. (1)
Ref.: Focht 1979, Focht 1986, Focht 1987 ( )(1), Tortić 1966 a, Tortić 1966 b, Tortić 1968 b, unp. Tkalčec & Mešić, unp. Tortić
Exs.: CNF
(Lit.: Galli 1998, Lannoy & Estades 2001, Pilát & Dermek 1974)

Leccinum Gray
= *Krombholzia* P. Karst. (nom. illeg.)
= *Krombholziella* Maire

(Lit.: Alessio 1985, Arnolds *& al.* 1995, Bollmann *& al.* 1996, Breitenbach & Kränzlin 1991, Engel 1983, Galli 1998, Hansen & Knudsen 1992, Kreisel 1987, Lannoy & Estades 1995, Lannoy & Estades 2001, Pilát & Dermek 1974, Rauschert 1987, Singer 1966, Singer 1986, Watling 1970)

•***Leccinum carpini*** (R. Schulz) Moser ex D.A. Reid
= *Krombholziella carpini* (R. Schulz) Alessio
= *Leccinum griseum* (Quél.) Singer (nom. illeg.) (1)
= *Leccinum pseudoscabrum* (Kallenb.) Šutara

Ref.: Barčić 1982 (1), Barčić 1996 (1), Focht 1972, Focht 1984 (1), Focht 1986 (1), Focht 1987 ( )(1), Kranjčev 1985 (1), Kranjčev 1995, Mužic & Božac 1997 (1), Tortić 1964, Tortić 1966 a, Tortić 1966 b, Tortić & Lisiewska 1978 (1), unp. Matočec, unp. Tkalčec & Mešić, unp. Tortić
Exs.: CNF
(Lit.: Engel 1983, Lannoy & Estades 1995, Pilát & Dermek 1974)

•***Leccinum corsicum*** (Rolland) Singer
= *Boletus sardous* Belli et Sacc.
Ref.: unp. Tkalčec & Mešić
Exs.: CNF
(Lit.: Galli 1998, Lannoy & Estades 1995)

Leccinum corsicum (Rolland) Singer **sensu lato**
Incl.: *Leccinum corsicum* (Rolland) Singer (1)
= *Krombholziella corsica* (Rolland) Alessio
Leccinum lepidum (P. Bouchet) Quadr.
= *Krombholziella lepida* (P. Bouchet) Alessio
Ref.: Focht 1984 (1), Focht 1986 (1), Focht 1987 (1), Božac 1986 HR? (1)
Annotation: Authors of the records for Croatia do not make distinction between these two species, so without revision it is not possible to know which species the authors have found.

•***Leccinum duriusculum*** (Schulzer) Singer
= *Boletus duriusculus* Schulzer (1)
= *Krombholziella duriuscula* (Schulzer) Imler
= *Leccinum decipiens* (Singer) Pilát et Dermek (2)
Ref.: Focht 1984, Focht 1986 ( )(2), Focht 1987 (2), Kalchbrenner & Schulzer 1873-1877 (1), Kallenbach 1926-1942 (1), Kranjčev 1986, Kranjčev 1995 ( )(2), Lorinser - Janda 1877 (1), Schulzer *& al.* 1866 (nom. nud.) (1), unp. Tkalčec & Mešić, unp. Tortić (2), Fries 1874 HR? (1), Saccardo 1888 HR? (1)
Exs.: CNF
(Lit.: Galli 1998, Lannoy & Estades 1995)

*•***Leccinum lepidum*** (P. Bouchet) Quadr.
= *Krombholziella lepida* (P. Bouchet) Alessio
Ref.: unp. Tkalčec & Mešić
Exs.: CNF
(Lit.: Galli 1998, Lannoy & Estades 1995)

Leccinum piceinum Pilát et Dermek
Ref.: Focht 1984, Focht 1986, Focht 1987

•***Leccinum quercinum*** Pilát
= *Krombholziella quercina* (Pilát) Šutara

Ref.: Focht 1986, Focht 1987, Kranjčev 1995, unp. Matočec, unp. Tkalčec & Mešić, unp. Tortić
Exs.: CNF
(Lit.: Engel 1983, Lannoy & Estades 1995)

•***Leccinum rufum*** (Schaeff.) Kreisel
= *Boletopsis rufa* (Schaeff.) Henn. (1)
= *Boletus rufus* Schaeff. (2)
= *Krombholziella rufa* (Schaeff.) Alessio
= *Boletus aurantiacus* Bull. (3)
= *Leccinum aurantiacum* (Bull.) Gray (4)
Ref.: Blagaić 1921 b (2), Blagaić 1931 a (2), Focht 1979 (4), Frković 1998 (2), Kranjčev 1986 b (4), Schulzer *& al.* 1866 (2)(3), Škorić 1928 (1), Tortić 1964 (4), Tortić 1966 b (4), Tortić 1968 a (4), Vouk & Pevalek 1916 (1), unp. Matočec (4), unp. Tkalčec & Mešić, unp. Tortić (2)(4), Tortić 1966 a ? (4)
Exs.: CNF
(Lit.: Engel 1983, Lannoy & Estades 1995)

Leccinum scabrum (Bull. : Fr.) Gray
= *Boletus scaber* Bull. : Fr. (1)
= *Krombholziella scabra* (Bull. : Fr.) Maire
Ref.: Barčić 1982, Barčić 1996, Blagaić 1921 (1), Blagaić 1931 a (1), Kranjčev 1986, Kranjčev 1995, Lorinser - Janda 1877 (1), Schulzer 1882 (1), Schulzer *& al.* 1866 (1), Škorić 1928 (1), Tortić 1964, Tortić 1966 a, Tortić 1966 b, Tortić 1968 a, Vouk & Pevalek 1916 (1), unp. Tortić ( )(1), Schulzer 1857 HR? (1)
Exs.: CNF

var. ***scabrum***
Ref.: Focht 1987 (as *L. scabrum*), Focht 1979 HR? (as *L. scabrum*)

var. ***cinnamomeum*** (Vassilkov) Krieglst.
= *Leccinum subcinnamomeum* Pilát et Dermek (2)
Ref.: Focht 1984 (2), Focht 1986 (2), Focht 1987 (2)
Exs.: CNF

var. ***melaneum*** (Smotl.) Dermek
= *Leccinum melaneum* (Smotl.) Pilát et Dermek (3)
Ref.: Focht 1984 (3), Focht 1986 (3), Focht 1987 (3), Kranjčev 1995 (3)

•***Leccinum tesselatum*** (Gillet → Kuntze) Rauschert
= *Leccinum crocipodium* (Letell. ex J.-E. Gilbert) Watling (1)
= *Krombholziella luteopora* (Bouchinot) Alessio
= *Leccinum luteoporum* (Bouchinot) Šutara
= *Boletus nigrescens* Richon et Roze (nom. illeg.) (2)
= *Krombholziella nigrescens* (Richon et Roze → Singer) Šutara

= *Leccinum nigrescens* (Richon et Roze →) Singer (3)
Misappl.: *Boletus rimosus* A. Venturi sensu Kallenb. non A. Venturi (4) (sensu A. Venturi = nom. dub. - Singer 1966)
Ref.: Focht 1984 (3), Focht 1986 (3), Focht 1987 (3), Kišpatić 1950 (2), Kranjčev 1995 (1), Lannoy & Estades 1995 (1), Tortić 1964 (3), Tortić & Lisiewska 1978 (1), unp. Lisiewska (1), unp. Matočec (1), unp. Tkalčec & Mešić, unp. Tortić (3)(4)
Exs.: CNF, POZM (1)
(Lit.: Engel 1983, Lannoy & Estades 1995)

•***Leccinum versipelle*** (Fr.) Snell
= *Boletus versipellis* Fr. (1)
= *Krombholziella versipellis* (Fr.) Alessio
= *Leccinum rufescens* (Konrad) Šutara (2)
= *Leccinum testaceoscabrum* (Secr.) Singer (nom. inval.) (3)
Ref.: Focht 1979 (2), Focht 1984 (3), Focht 1986 (3), Focht 1987 (3), Gjurašin 1898 (1), Kranjčev 1986 (3), unp. Tkalčec & Mešić, Tortić 1966 a ? (3)
Exs.: CNF
(Lit.: Engel 1983, Galli 1998, Lannoy & Estades 1995)

Leccinum vulpinum Watling
= *Krombholziella vulpina* (Watling) Šutara
Ref.: Focht 1984, Focht 1986, Focht 1987

Phylloporus Quél.

(Lit.: Arnolds *& al.* 1995, Both 1993, Engel *& al.* 1996, Galli 1998, Hansen & Knudsen 1992, Kreisel 1987, Lannoy & Estades 2001, Moser 1983, Pilát & Dermek 1974, Singer 1964, Singer 1986)

•***Phylloporus pelletieri*** (Lév.) Quél.
= *Paxillus pelletieri* (Lév.) Velen. (1)
= *Phylloporus rhodoxanthus* (Schwein. : Fr.) Bres. subsp. *europaeus* Singer
- as *Phylloporus rhodoxanthus* (Schwein. : Fr.) Bres. (2)
Ref.: Focht 1984 (2), Focht 1986 (2), Focht 1987 (2), Lange 1974 (2), Tortić 1968 b (2), Tortić & Lisiewska 1978 (2), Vouk & Pevalek 1916 (1), unp. Lisiewska (2), unp. Matočec (2), unp. Tkalčec & Mešić, unp. Tortić (2)
Exs.: CNF, POZM (2)
(Lit.: Engel *& al.* 1996, Pilát & Dermek 1974)
Annotation: Most modern authors consider that European records of *Phylloporus rhodoxanthus* (subsp. *europaeus*) belong to an autonomous species *P. pelletieri*, and that *P. rhodoxanthus* (subsp. *rhodoxanthus*) is not recorded in Europe.

Porphyrellus J.-E. Gilbert

(Lit.: Alessio 1985, Galli 1998, Hansen & Knudsen 1992, Kreisel 1987, Lannoy & Estades 2001, Moser 1983, Pilát & Dermek 1974, Singer 1966, Singer 1986)

Porphyrellus porphyrosporus (Fr.) J.-E. Gilbert
= *Tylopilus porphyrosporus* (Fr.) A.H. Sm. et Thiers
= *Porphyrellus pseudoscaber* (Secr.) Singer (nom. inval.) (1)
Ref.: Focht 1974, Lange 1974 (1), Tortić 1966 b (1), unp. Matočec (1), unp. Tortić (1)

Pulveroboletus Murrill
= *Buchwaldoboletus* Pilát

(Lit.: Alessio 1985, Alessio 1991, Arnolds *& al.* 1995, Fries 1836-1838, Galli 1998, Hansen & Knudsen 1992, Kreisel 1987, Lannoy & Estades 2001, Moser 1983, Pilát & Dermek 1974, Singer 1966, Singer 1986)

•***Pulveroboletus hemichrysus*** (Berk. et M.A. Curtis) Singer
= *Buchwaldoboletus hemichrysus* (Berk. et M.A. Curtis) Pilát
= *Phlebopus sulfureus* (Fr. → Quél.) Singer (1)
Ref.: Focht 1974 (1), Focht 1984, Focht 1986, Focht 1987, unp. Tkalčec & Mešić
Exs.: CNF
(Lit.: Lannoy & Estades 2001, Pilát & Dermek 1974, Singer 1966)

*•***Pulveroboletus lignicola*** (Kallenb.) Pilát
= *Buchwaldoboletus lignicola* (Kallenb.) Pilát
Ref.: unp. Tkalčec & Mešić
Exs.: CNF
(Lit.: Pilát & Dermek 1974, Singer 1966)

Strobilomyces Berk.

(Lit.: Alessio 1985, Arnolds *& al.* 1995, Galli 1998, Hansen & Knudsen 1992, Kreisel 1987, Lannoy & Estades 2001, Moser 1983, Pilát & Dermek 1974, Singer 1966, Singer 1986)

•***Strobilomyces strobilaceus*** (Scop. : Fr.) Berk.
= *Boletus strobilaceus* Scop. : Fr. (1)
= *Strobilomyces floccopus* (Vahl : Fr.) P. Karst. (2)
Ref.: Blagaić 1921 (1), Gjurašin 1898 (1), Kranjčev 1986 (2), Kranjčev 1995 (2), Lange 1974 (2), Škorić 1928, Tortić 1964 (2), Tortić 1966 b (2), Tortić 1993, Vouk & Pevalek 1916, unp. Lindtner (2), unp. Matočec (2), unp. Tkalčec & Mešić, unp. Tortić ( )(2)
Exs.: BEO (2), CNF
(Lit.: Galli 1998, Pilát & Dermek 1974)

Suillus P. Micheli ex Adans.

(Lit.: Alessio 1985, Arnolds *& al.* 1995, Engel *& al.* 1996, Galli 1998, Hansen & Knudsen 1992, Kallenbach 1926-1942, Kreisel 1987, Lannoy & Estades 2001, Merlo *& al.* 1983, Moser 1983, Pilát & Dermek 1974, Rauschert 1987, Redeuilh & Simonini 1998, Singer 1964, Singer 1986)

Suillus alboflocculosus Watling et Pantidou
Ref.: Focht 1984, Focht 1986, Focht 1987
Exs.: CNF

•***Suillus bellinii*** (Inzenga) Kuntze
= *Boletus boudieri* Quél. (1)
= *Suillus boudieri* (Quél.) Watling (2)
Ref.: Engel *& al.* 1996, Focht 1974 (2), Focht 1984 ( )(2), Focht 1986 ( )(2), Focht 1987 ( )(2), Vouk & Pevalek 1916 (1), Vrščaj 1990, unp. Köppl (according to Voglmayr), unp. Tkalčec & Mešić, Božac 1984 HR?, Božac 1986 HR?, Božac 1989 HR?, Božac 1993 HR?
Exs.: CNF, WU
(Lit.: Engel *& al.* 1996, Galli 1998)

•***Suillus bovinus*** (L. : Fr.) Roussel
= *Boletus bovinus* L. : Fr. (1)
Ref.: Blagaić 1931 a (1), Focht 1981 b, Focht 1987, Lange 1974, Tortić 1966 a, Vouk & Pevalek 1915 (1), Vouk & Pevalek 1916 (1), unp. Matočec, unp. Tkalčec & Mešić, unp. Tortić
Exs.: CNF
(Lit.: Engel *& al.* 1996, Galli 1998, Pilát & Dermek 1974)

•***Suillus collinitus*** (Fr.) Kuntze
= *Suillus fluryi* Huijsman (1)
Ref.: Focht 1972, Focht 1974, Focht 1984, Focht 1986, Focht 1987, unp. Pouzar (according to unp. Tortić) (1), unp. Tkalčec & Mešić
Exs.: CNF, PRM (1)
(Lit.: Alessio 1985, Moser 1983)

•***Suillus granulatus*** (L. : Fr.) Roussel
= *Boletus granulatus* L. : Fr. (1)
Ref.: Blagaić 1921 (1), Blagaić 1931 a (1), Focht 1972, Focht 1984, Focht 1987, Gjurašin 1898 (1), Kranjčev 1995, Lisiewska & Tortić 1990, Mužic & Božac 1984, Tortić 1964, Tortić 1966 a, Tortić 1966 b, Vouk & Pevalek 1915 (1), unp. Matočec, unp. Tkalčec & Mešić, unp. Tortić ( )(1)
Exs.: CNF
(Lit.: Alessio 1985, Moser 1983, Pilát & Dermek 1974)

•***Suillus grevillei*** (Klotzsch : Fr.) Singer
= *Boletus elegans* Schumach. (nom. illeg.) non *B. elegans* Bull. (1)
= *Suillus elegans* (Schumach. →) Snell (2)

= *Boletopsis flava* (With.) Henn. (3)
= *Boletus flavus* With. (4)
Ref.: Blagaić 1931 a (1), Focht 1979 (2), Kallenbach 1926-1942 (4), Kranjčev 1995, Lorinser - Janda 1877 (1)(4), Tortić 1968 b, Vouk & Pevalek 1915 (1)(4), Vouk & Pevalek 1916 (3), unp. Matočec, unp. Tkalčec & Mešić, unp. Tortić
Exs.: CNF
(Lit.: Engel *& al.* 1996, Galli 1998, Pilát & Dermek 1974)

•***Suillus laricinus*** (Berk.) Kuntze
= *Suillus aeruginascens* (Secr. ex Opat.) Snell (1)
Misappl.: *Boletus viscidus* L. sensu auct. non L. (2)
Misappl.: *Suillus viscidus* (L.) Roussel sensu auct. non L. (3)
- as *Suillus bresadolae* (Quél.) Gerhold (4)
Ref.: Engel *& al.* 1996 (rev.) (4), Kallenbach 1926-1942 (2), Tortić 1968 b (1), unp. Tkalčec & Mešić, unp. Tortić (1)(3)
Exs.: CNF
(Lit.: Engel *& al.* 1996, Galli 1998)
Annotation: Engel *& al.* (1996) quote this species for Croatia according to personal communication by Z. Tkalčec and M. Tortić. Subsequent revision of this material showed that this is a dark brown form of *Suillus laricinus*.

•***Suillus luteus*** (L. : Fr.) Roussel
= *Boletopsis lutea* (L. : Fr.) Henn. (1)
= *Boletus luteus* L. : Fr. (2)
= *Boletus annularius* Bolton (3)
Ref.: Barčić 1982, Barčić 1996, Blagaić 1931 a (2), Focht 1981 a, Focht 1987, Gjurašin 1898 (2), Kallenbach 1926-1942 (2), Kranjčev 1995, Lisiewska & Tortić 1990, Lorinser - Janda 1877 (2), Schulzer 1867 (3), Škorić 1928 (1), Tortić 1964, Tortić 1966 a, Tortić 1966 b, Vouk & Pevalek 1915 (2), unp. Matočec, unp. Tkalčec & Mešić, unp. Tortić ( ) (2)
Exs.: CNF
(Lit.: Engel *& al.* 1996, Galli 1998, Pilát & Dermek 1974)

•***Suillus placidus*** (Bonord.) Singer
= *Gyrodon placidus* (Bonord.) Sacc. (1)
Ref.: Blagaić 1923 (1), Focht 1984, Focht 1986, Focht 1987, unp. Tkalčec & Mešić, unp. Tortić
Exs.: CNF
(Lit.: Engel *& al.* 1996, Galli 1998, Pilát & Dermek 1974)

Suillus tridentinus (Bres.) Singer
Ref.: Engel *& al.* 1996, unp. Tortić
Exs.: CNF

•***Suillus variegatus*** (Sw. : Fr.) Richon et Roze
= *Boletus variegatus* Sw. : Fr. (1)

Ref.: Blagaić 1931 a (1), Focht 1987, unp. Tkalčec & Mešić
Exs.: CNF
(Lit.: Engel *& al.* 1996, Galli 1998, Pilát & Dermek 1974)

Tylopilus P. Karst.

(Lit.: Alessio 1985, Arnolds *& al.* 1995, Galli 1998, Hansen & Knudsen 1992, Kreisel 1987, Lannoy & Estades 2001, Moser 1983, Pilát & Dermek 1974, Singer 1966, Singer 1986)

•***Tylopilus felleus*** (Bull. : Fr.) P. Karst.
= *Boletus felleus* Bull. : Fr. (1)
Ref.: Blagaić 1921 (1), Blagaić 1931 b (1), Focht 1987, Kallenbach 1926-1942 (1), Tortić 1964, Tortić 1973, Tortić & Lisiewska 1978, unp. Tortić ( )(1)
Exs.: CNF

•var. ***felleus***
Ref.: unp. Tkalčec & Mešić
(Lit.: Pilát & Dermek 1974, Singer 1966)

var. ***alutarius*** (Fr.) P. Karst.
= *Tylopilus alutarius* (Fr.) Henn. (2)
Ref.: Vouk & Pevalek 1916 (2)

•var. ***fuscescens*** P. Karst.
Ref.: Focht 1984, Focht 1987, unp. Tkalčec & Mešić
Exs.: CNF
(Lit.: Pilát & Dermek 1974, Singer 1966)

Xerocomus Quél.

(Lit.: Alessio 1985, Alessio 1991, Arnolds *& al.* 1995, Bollmann *& al.* 1996, Engel *& al.* 1996, Galli 1998, Hansen & Knudsen 1992, Kreisel 1987, Lannoy & Estades 2001, Moser 1983, Pilát & Dermek 1974, Redeuilh & Simonini 1995, Singer 1964, Singer 1986, Watling 1970)

Xerocomus armeniacus (Quél.) Quél.
= *Boletus armeniacus* Quél. (1)
Ref.: Focht 1974 (1), Focht 1984, Focht 1986, Focht 1987

•***Xerocomus badius*** (Fr. : Fr.) Kühner ex J.-E. Gilbert
= *Boletus badius* (Fr. : Fr.) Fr. (1)
Ref.: Focht 1979 (1), Focht 1987, Kallenbach 1926-1942 (1), Tortić 1964, Tortić 1966 a, Tortić 1966 b, Vouk & Pevalek 1916 (1), unp. Matočec, unp. Tkalčec & Mešić, unp. Tortić ( )(1)
Exs.: CNF
(Lit.: Engel *& al.* 1996, Pilát & Dermek 1974)

Xerocomus chrysenteron (Bull.) Quél.
= *Boletus chrysenteron* Bull. (1)
Ref.: Barčić 1982, Barčić 1984, Barčić 1996, Blagaić 1931 a (1), Focht 1986, Focht 1987, Gjurašin 1898 (1), Kranjčev 1995, Škorić 1928 (1), Tortić 1964, Tortić 1966 a, Tortić 1966 b, Tortić 1993, Tortić & Lisiewska 1978, Vouk & Pevalek 1916 (1), unp. Kotlaba (according to unp. Tortić), unp. Matočec, unp. Tortić ( )(1)
Exs.: CNF, PRM

Xerocomus ferrugineus (Schaeff.) Bon
= *Boletus ferrugineus* Schaeff.
= *Xerocomus subtomentosus* (L. : Fr.) Quél. var. *ferrugineus* (Schaeff.) Krieglst.
= *Boletus fuscus* Rostk. (1)
= *Xerocomus spadiceus* (Fr.) Quel. (nom. illeg.) (2)
= *Boletus subtomentosus* L. : Fr. var. *leguei* (Boud.) Bataille
= *Xerocomus subtomentosus* (L. : Fr.) Quél. var. *leguei* (Boud.) Maire
Ref.: Focht 1984 (2), Focht 1986 (2), Focht 1987 (2), Vouk & Pevalek 1916 (1), unp. Matočec (2)

•***Xerocomus moravicus*** (Vacek) Herink
= *Boletus moravicus* Vacek
= *Xerocomus leonis* D.A. Reid
Misappl.: *Xerocomus tumidus* (Fr.) J.-E. Gilbert sensu auct. non Fr. (sensu Fr. = *Xerocomus badius* (Fr. : Fr.) Kühner ex J.-E. Gilbert - Pilát & Dermek 1974; = nom. dub. - Redeuilh & Simonini 1995)
Ref.: Focht 1984, Focht 1986, unp. Tkalčec & Mešić
Exs.: CNF
(Lit.: Engel *& al.* 1996, Pilát & Dermek 1974)

•***Xerocomus parasiticus*** (Bull. : Fr.) Quél.
= *Boletus parasiticus* Bull. : Fr.
Ref.: Focht 1984, Focht 1986, Focht 1987, unp. Tkalčec & Mešić
Exs.: CNF
(Lit.: Engel *& al.* 1996, Pilát & Dermek 1974)

Xerocomus pascuus (Pers.) J.-E. Gilbert
= *Boletellus pruinatus* (Fr.) Klofac et Krisai var. *pascuus* (Pers.) Klofac et Krisai
= *Boletus subtomentosus* L. : Fr. var. *pascuus* Pers. (1)
Ref.: Schulzer *& al.* 1866 (1)

•***Xerocomus porosporus*** Imler
= *Boletus porosporus* (Imler) Watling
Misappl.: *Xerocomus truncatus* Singer, Snell et E.A. Dick sensu auct. europ. non Singer, Snell et E.A. Dick (1)
Ref.: Focht 1984 (1), Focht 1987 (1), unp. Tkalčec & Mešić, unp. Tortić (1)

Exs.: CNF
(Lit.: Moser 1983, Pilát & Dermek 1974)

Xerocomus pruinatus (Fr.) Quél.
= *Boletellus pruinatus* (Fr.) Klofac et Krisai
= *Boletus pruinatus* Fr. (1)
= *Xerocomus fragilipes* (C. Martin) Pouzar
Ref.: Gjurašin 1898 (1)

Xerocomus rubellus (Krombh.) Quél.
= *Boletus rubellus* Krombh. (1)
= *Boletus sanguineus* With. (nom. illeg.) non *B. sanguineus* L. : Fr. (2)
= *Boletus versicolor* Rostk. (nom. illeg.) non *B. versicolor* L. : Fr. (3)
= *Xerocomus versicolor* (Rostk. → Kuntze) J.-E. Gilbert (4)
Ref.: Blagaić 1931 a (3), Focht 1974 (1), Focht 1979 (1), Jelić & Tortić 1973, Kallenbach 1926-1942 (2), Kranjčev 1995 (1), Tortić 1964, unp. Matočec, unp. Tortić ( )(3)(4)
Exs.: CNF

Xerocomus subtomentosus (L. : Fr.) Quél.
= *Boletus subtomentosus* L. : Fr. (1)
Ref.: Barčić 1982, Barčić 1996, Blagaić 1931 a (1), Božac 1989, Božac 1993, Focht 1987, Kranjčev 1995, Lorinser - Janda 1877 (1), Schulzer 1882 (1), Schulzer *& al.* 1866 (1), Tortić 1964, Tortić 1966 a, Tortić & Lisiewska 1978, Vouk & Pevalek 1916 (1), unp. Matočec, unp. Tkalčec & Mešić, unp. Tortić ( )(1), Focht 1986 HR?, Schulzer 1857 HR? (1)
Exs.: CNF

Family **Gomphidiaceae** Maire ex Jülich

Chroogomphus (Singer) O.K. Mill.

(Lit.: Arnolds *& al.* 1995, Fries 1874, Hansen & Knudsen 1992, Kreisel 1987, Moser 1983, Pilát & Dermek 1974, Singer 1986, Singer & Kuthan 1976 b)

•***Chroogomphus helveticus*** (Singer) Moser

*•subsp. ***helveticus***
Ref.: unp. Tkalčec & Mešić
Exs.: CNF
(Lit.: Singer & Kuthan 1976 b)

subsp. ***tatrensis*** (Pilát) Kuthan et Singer
Ref.: Focht 1986

•***Chroogomphus rutilus*** (Schaeff. : Fr.) O.K. Mill.
= *Gomphidius rutilus* (Schaeff. : Fr.) S. Lundell et Nannf. (1)
= *Gomphidius testaceus* (Fr.) Britzelm. (2)
= *Gomphidius viscidus* (L.) Fr. (3)

Ref.: Blagaić 1921 (3), Focht 1974 (3), Focht 1979 (3), Focht 1981 b (3), Gjurašin 1898 (3), Mužic & Božac 1984, Schulzer 1882 (2), Tortić 1964 (1), Tortić 1966 a (1), Tortić 1966 b (1), unp. Matočec, unp. Tkalčec & Mešić, unp. Tortić (1)(3), Focht 1983 a HR? (3)
Exs.: CNF
(Lit.: Moser 1983, Pilát & Dermek 1974)

Gomphidius Fr.

(Lit.: Arnolds *& al.* 1995, Fries 1874, Hansen & Knudsen 1992, Kreisel 1987, Moser 1983, Pilát & Dermek 1974, Singer 1986)

•***Gomphidius glutinosus*** (Schaeff. : Fr.) Fr.
Ref.: Focht 1974, Škorić 1928, Vouk & Pevalek 1916, unp. Matočec, unp. Tkalčec & Mešić, unp. Tortić
Exs.: CNF
(Lit.: Hansen & Knudsen 1992, Moser 1983, Pilát & Dermek 1974)

Gomphidius maculatus (Scop.) Fr.
Ref.: Vouk & Pevalek 1916

*•***Gomphidius roseus*** (Fr.) P. Karst.
Ref.: unp. Matočec, unp. Tkalčec & Mešić, unp. Tortić
Exs.: CNF
(Lit.: Hansen & Knudsen 1992, Moser 1983, Pilát & Dermek 1974)

Family **Paxillaceae** Lotsy

Hygrophoropsis (J. Schröt.) Maire

(Lit.: Arnolds *& al.* 1995, Bas *& al.* 1995, Hansen & Knudsen 1992, Kreisel 1987, Moser 1983, Singer 1986)

•***Hygrophoropsis aurantiaca*** (Wulfen : Fr.) Maire
= *Cantharellus aurantiacus* (Wulfen : Fr.) Fr. (1)
= *Clitocybe aurantiaca* (Wulfen : Fr.) Studer (2)
Ref.: Barčić 1982, Barčić 1996, Focht 1974, Lorinser - Janda 1877 (1), Tortić 1964, Tortić 1966 a, Tortić 1966 b, Tortić 1989, Vouk & Pevalek 1916 (1), unp. Matočec, unp. Tkalčec & Mešić, unp. Tortić ( )(2)
Exs.: CNF
(Lit.: Bas *& al.* 1995, Moser 1983)

Omphalotus Fayod

(Lit.: Bas *& al.* 1995, Hansen & Knudsen 1992, Kirchmair *& al.* 2002, Kreisel 1987, Moser 1983, Pilát 1935, Pilát 1951, Schulzer 1875, Singer 1986)

•***Omphalotus olearius*** (DC. : Fr.) Singer
= *Agaricus olearius* DC. : Fr. (1)

= *Clitocybe olearia* (DC. : Fr.) Maire (2)
= *Pleurotus olearius* (DC. : Fr.) Gillet (3)
= *Agaricus superbiens* Schulzer (5)
= *Agaricus zizyphinus* Viv. (6)
= *Clitocybe zizyphina* (Viv.) ? (7)
= *Pleurotus olearius* (DC. : Fr.) Gillet f. *zizyphinus* (Viv.) Nüesch (8)
Ref.: Barčić 1982, Barčić 1996, Blagaić 1923 (3), Focht 1972, Focht 1974, Focht 1979 (3), Lange 1974, Mužic & Božac 1997, Schulzer 1875 (1), Schulzer *& al.* 1866 (1), Tortić 1964, Tortić 1978, Tortić & Lisiewska 1978, Vrščaj 1990, unp. Lisiewska, unp. Matočec, unp. Tkalčec & Mešić, unp. Tortić 1970, unp. Tortić ( )(2)(3), Focht 1983 b HR?, Focht 1986 HR?, Fries 1874 HR? (6), Kalchbrenner & Schulzer 1873-1877 HR? (5), Pilát 1935 HR? (8), Saccardo 1887 HR? (7), Schulzer 1857 HR? (1), Schulzer 1862 HR? (1)
Exs.: BEO, CNF, POZM
(Lit.: Bas *& al.* 1995, Kirchmair *& al.* 2002)

Paxillus Fr.
= *Tapinella* J.-E. Gilbert

(Lit.: Arnolds *& al.* 1995, Bollmann *& al.* 1996, Hansen & Knudsen 1992, Kreisel 1987, Krieglsteiner 2000, Moser 1983, Singer 1986, Szczepka 1987, Watling 1970)

•***Paxillus atrotomentosus*** (Batsch : Fr.) Fr.
= *Tapinella atrotomentosa* (Batsch : Fr.) Šutara
Ref.: Barčić 1989, Barčić 1996, Focht 1972, Focht 1974, Lisiewska & Tortić 1990, Tortić 1964, Tortić 1989, unp. Tkalčec & Mešić, unp. Tortić
Exs.: CNF
(Lit.: Hansen & Knudsen 1992, Krieglsteiner 2000, Szczepka 1987)

*•***Paxillus filamentosus*** (Scop.) Fr.
= *Paxillus rubicundulus* P.D. Orton
Ref.: unp. Matočec, unp. Tkalčec & Mešić
Exs.: CNF
(Lit.: Hansen & Knudsen 1992, Krieglsteiner 2000, Szczepka 1987)

•***Paxillus involutus*** (Batsch : Fr.) Fr.
Ref.: Lorinser - Janda 1877, Schulzer *& al.* 1866, Tortić 1964, Tortić 1966 a, Tortić & Lisiewska 1978, Vouk & Pevalek 1915, Vouk & Pevalek 1916, unp. Matočec, unp. Tkalčec & Mešić, unp. Tortić
Exs.: CNF
(Lit.: Hansen & Knudsen 1992, Krieglsteiner 2000, Szczepka 1987)

•***Paxillus panuoides*** (Fr. : Fr.) Fr.
= *Tapinella panuoides* (Fr. : Fr.) J.-E. Gilbert
= *Paxillus acheruntius* (Humb.) J. Schröt. (1)

Ref.: Barčić 1989, Barčić 1996, Focht 1974, Šarić-Sabadoš 1957, Škorić 1928 (1), Tortić 1989, unp. Tortić
Exs.: CNF

•var. ***panuoides***
Ref.: unp. Tkalčec & Mešić
Exs.: CNF
(Lit.: Hansen & Knudsen 1992, Szczepka 1987)

*•var. ***ionipus*** (Quél.) Tkalčec et Mešić, **comb. nov.**
= *Paxillus ionipus* Quél. - Compt. Rend. Assoc. Franç. Avancem. Sci. 16(2): 588, 1888. (basionym)
Ref.: unp. Tkalčec & Mešić
Exs.: CNF
Annotation: This combination is already in use. However, to our knowledge, it has never been validly published.

EXCLUDED RECORDS

Family **Boletaceae** Cheval.

Boletus aureus Bull. = **?**
Ref.: Vouk & Pevalek 1916

Boletus fraternus Peck
Ref.: Focht 1987
Exs.: CNF
Annotation: A photograph of fruitbody which has been published by Focht (1987) clearly indicates that this is not *Boletus fraternus*. This record needs a detailed revision.

Boletus globularis Schulzer = **?**
Ref.: Schulzer 1879

Boletus jandae Schulzer
Ref.: Schulzer 1887
Annotation: Singer (1966) quotes this name as a synonym of *Boletus luridus* Schaeff. : Fr. However, colored drawing and description of this species in Schulzer's manuscript (in National and University Library in Zagreb) show that this is a synonym of *B. legaliae* (Pilát) Pilát et Ušák or *B. rhodoxanthus* (Krombh.) Kallenb. This species needs a detailed revision.

Boletus propinquus Schulzer = **?**
Ref.: Schulzer 1880 b

Boletus purpurascens Rostk.
Ref.: Vouk & Pevalek 1916
Annotation: According to Engel *& al.* (1996), Pilát & Dermek (1974) and Singer (1966) it could be a synonym of *Xerocomus rubellus* (Krombh.) Quél.

Boletus purpureus Pers. - nom. ambig.
Ref.: Focht 1974, Focht 1979, Tortić 1966 b, unp. Tortić, Tortić 1966 a ?
Exs.: CNF
Annotation: Without revision it is not possible to know which species the authors of the records for Croatia have found.

Boletus quercicola (Vassilkov) Singer
Ref.: Focht 1984, Focht 1986, Focht 1987, Kranjčev 1995
Annotation: This is a doubtful species. Most modern authors do not mention it, Singer (1977) considers it an autonomous species, while Engel *& al.* (1983) consider it a variety of *Boletus edulis* Bull. : Fr.

Boletus satanas Lenz sensu Hongo et Imazeki non Lenz
Ref.: Focht 1987
Annotation: Singer (1977) considers that it could be a new species. This record for Croatia surely needs revision.

Boletus schulzeri Quél.
Ref.: Saccardo 1888, Schulzer 1885
Annotation: According to Engel *& al.* (1983), Pilát & Dermek (1974) and Singer (1966) it could be a synonym of *Boletus luridus* Schaeff. : Fr. According to Merlo *& al.* (1983) it is a synonym of *B. queletii* Schulzer.

Boletus sericeus P. Micheli ex Pers.
Ref.: Schulzer 1857 HR?
Annotation: According to Engel *& al.* (1983), Pilát & Dermek (1974) and Singer (1966) it could be a synonym of *Boletus impolitus* Fr. (today we should take it in a broad sense, including *B. depilatus* Redeuilh).

Suillus leptopus (Pers.) A. Marchand (comb. inval.)
= *Boletus leptopus* (Pers.) ? (1)
Ref.: Focht 1972, Focht 1974, Focht 1984, Focht 1986, Focht 1987, unp. Lisiewska, Božac 1982 HR? (1), Mužic & Božac 1984 HR?, Mužic & Božac 1997 HR?
Exs.: CNF, POZM
Annotation: The epithet *leptopus* has been interpreted in different ways (see Alessio 1985, Engel *& al.* 1996, Redeuilh & Simonini 1998), so without revision it is not possible to know which species the authors of the quotes for Croatia have found.

Suillus littoralis (P. Bouchet) ?
= *Suillus leptopus* (Pers.) A. Marchand f. *littoralis* (P. Bouchet) ? (1)
Ref.: Focht 1972, Focht 1974, Focht 1984 (1), Focht 1986 (1), Focht 1987, Božac 1986 HR?, Focht 1983 a HR?
Annotation: Modern authors disagree about the interpretation of this taxon. Merlo *& al.* (1983) consider it an independent species, Engel *& al.* (1996) consider it a synonym of *Suillus mediterraneensis* (Jacquet. et J. Blum) Redeuilh, Redeuilh & Simonini (1998) consider it a synonym of *S. bellinii* (Inzenga) Kuntze, while Galli (1998) considers it a nomen ambiguum.

Family **Paxillaceae** Lotsy

Paxillus chrysophyllus Trog = ?
Ref.: Vouk & Pevalek 1915

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PRELIMINARY CHECKLIST OF AGARICALES FROM CROATIA IV: FAMILIES BOLBITIACEAE, COPRINACEAE, ENTOLOMATACEAE AND PLUTEACEAE

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ABSTRACT

The fourth part of the preliminary checklist of Agaricales from Croatia is given. It comprises the families Bolbitiaceae, Coprinaceae, Entolomataceae and Pluteaceae. 96 species (one of them in a broad sense) belonging to 13 genera are presented. One genus and 19 species are reported for the first time from Croatia. For each species, the published and unpublished sources of data are given, as well as the collections in which the material is deposited.

Key words: Basidiomycota, biodiversity, mycoflora, bibliography

INTRODUCTION

This is the fourth part of the preliminary checklist of Agaricales from Croatia. The first three parts have been published in Mycotaxon (Tkalčec & Mešić 2002, Mešić & Tkalčec 2002, Tkalčec & Mešić 2003). This part comprises the families Bolbitiaceae, Coprinaceae, Entolomataceae and Pluteaceae. The checklist includes data published or collected before 1 January 2000. Information about the geographical and biogeographical position of Croatia, material, methods and presentation are given in Tkalčec & Mešić (2002).

In this paper we present 96 species (one of them in a broad sense) belonging to 13 genera found on the territory of Croatia, of which we have revised 54 species. Out of the overall number 11 species belong to the family Bolbitiaceae, 35 species to the family Coprinaceae, 27 species to the family Entolomataceae and 23 species to the family Pluteaceae. One genus and 19 species are reported for the first time from Croatia.

Marks and abbreviations:

* - taxon reported for the first time from Croatia in this paper;
• - at least part of records of taxon revised;
(1) - number in brackets indicates synonym or misapplied name under which the author of the record has quoted the taxon;
( ) - empty brackets indicate that the author of the record has also quoted the taxon under the name we use;
? - (a) question mark instead of an author of combination means that we could not find the author in the literature available to us; (b) question mark following the source of a published record or abbreviation of a collection means that the author himself doubted his original identification;
= ? - taxon not found in modern taxonomic literature;
Exs. - collections in which the dried material (exsiccatum) is deposited;
HR? - taxon most probably found in the territory of Croatia (locality not precisely quoted);
Incl. - including;
Lit. - literature;
Misappl. - misapplied name;
Ref. - references (sources of records of taxon);
unp. - unpublished data.

SURVEY OF TAXA

Family **Bolbitiaceae** Singer

Agrocybe Fayod

(Lit.: Arnolds *& al.* 1995, Hansen & Knudsen 1992, Kreisel 1987, Moser 1983, Nauta 1987, Schulzer 1867, Singer 1986)

•***Agrocybe cylindracea*** (DC. : Fr.) Maire
= *Agrocybe aegerita* (V. Brig.) Singer (1)
= *Pholiota aegerita* (V. Brig.) Quél. (2)
Ref.: Blagaić 1923 (2), Blagaić 1931 (2), Focht 1974 (2), Focht 1979 (2), Focht 1983 (2), Focht 1986 (1), Tortić 1964 (1), Tortić 1978 (1), unp. Lisiewska (1), unp. Mešić & Tkalčec, unp. Tortić (1)(2)

Exs.: CNF, POZM (1)
(Lit.: Hansen & Knudsen 1992, Moser 1983, Nauta 1987)

•***Agrocybe dura*** (Bolton) Singer
= *Agrocybe molesta* (Lasch) Singer
Ref.: Tortić 1968 b, unp. Matočec, unp. Mešić & Tkalčec, unp. Tortić
Exs.: CNF
(Lit.: Hansen & Knudsen 1992, Moser 1983, Nauta 1987)

•***Agrocybe erebia*** (Fr. : Fr.) Kühner
Ref.: Tortić 1973, unp. Mešić & Tkalčec, unp. Tortić
Exs.: CNF
(Lit.: Moser 1983, Nauta 1987)

•***Agrocybe pediades*** (Fr. : Fr.) Fayod
= *Agaricus retroflexus* Schulzer (nom. nud.) (1)
= *Agaricus semiorbicularis* Bull. (2)
= *Agrocybe semiorbicularis* (Bull.) Fayod
Ref.: Schulzer *& al.* 1866 (1) + Schulzer 1867 (2), unp. Mešić & Tkalčec
Exs.: CNF
(Lit.: Hansen & Knudsen 1992, Nauta 1987)

•***Agrocybe praecox*** (Pers. : Fr.) Fayod
= *Agaricus praecox* Pers. : Fr. (1)
= *Pholiota praecox* (Pers. : Fr.) P. Kumm. (2)
Ref.: Barčić 1982, Barčić 1996, Blagaić 1931 (2), Pilát 1925 (2), Schulzer *& al.* 1866 (1), Tortić 1966 a, Tortić 1966 b, Tortić 1968 b, unp. Matočec, unp. Mešić & Tkalčec, unp. Tortić ( )(2), Schulzer 1857 HR? (1)
Exs.: CNF
(Lit.: Hansen & Knudsen 1992, Moser 1983, Nauta 1987)

Bolbitius Fr.

(Lit.: Arnolds *& al.* 1995, Bon 1992, Breitenbach & Kränzlin 1995, Hansen & Knudsen 1992, Kreisel 1987, Moser 1983, Singer 1977, Singer 1986)

•***Bolbitius titubans*** (Bull. : Fr.) Fr.
= *Agaricus titubans* Bull. : Fr. (1)
= *Bolbitius vitellinus* (Pers. : Fr.) Fr. var. *titubans* (Bull. : Fr.) ? (2)
= *Agaricus boltonii* Pers. : Fr. (3)
= *Bolbitius vitellinus* (Pers. : Fr.) Fr. (4)
Ref.: Focht 1972 (4), Focht 1974 (4), Schulzer *& al.* 1866, unp. Matočec (4), unp. Mešić & Tkalčec, unp. Tortić (2)(4), Schulzer 1857 HR? (1)(3)
Exs.: CNF
(Lit.: Bon 1992, Moser 1983)

•***Bolbitius variicolor*** G.F. Atk.
= *Bolbitius vitellinus* (Pers. : Fr.) Fr. var. *variicolor* (G.F. Atk.) Krieglst.

Ref.: Tkalčec & Kusin 1984, unp. Matočec, unp. Mešić & Tkalčec
Exs.: CNF
(Lit.: Bon 1992, Moser 1983, Singer 1977)

Conocybe Fayod
= *Pholiotina* Fayod

(Lit.: Arnolds *& al.* 1995, Bon 1992, Enderle 1991, Enderle 1997, Fries 1874, Hansen & Knudsen 1992, Kreisel 1987, Singer 1986, Watling 1980)

Conocybe blattaria (Fr. : Fr.) Kühner **sensu lato**
Incl.: *Conocybe aporos* Kits van Wav.
Conocybe arrhenii (Fr.) Kits van Wav.
Conocybe blattaria (Fr. : Fr.) Kühner
= *Pholiotina blattaria* (Fr. : Fr.) Fayod (1)
Conocybe vexans P.D. Orton
= *Pholiotina togularis* (Bull. : Fr.) Fayod (2)
Ref.: unp. Matočec (1), unp. Tortić (1)(2)
Exs.: CNF
Annotation: Epithets *blattaria* and *togularis* have been used in a few different senses, so without revision it is not possible to know which species the authors of the records for Croatia have found. Some authors consider that *Conocybe blattaria* is conspecific with *C. vexans* (Enderle 1997, Kreisel 1987, Singer 1986).

Conocybe conocephala (Bull. : Fr.) Bon
= *Bolbitius conocephalus* (Bull. : Fr.) Fr. (1)
= *Galerella conocephala* (Bull. : Fr.) Bon
Ref.: Vouk & Pevalek 1915 (1), Vouk & Pevalek 1916 (1)

Conocybe semiglobata Kühner et Watling
= *Conocybe tenera* (Schaeff. : Fr.) Fayod var. *semiglobata* (Kühner) ? (nom. inval.) (1)
Ref.: Focht 1974 (1)

Conocybe tenera (Schaeff. : Fr.) Fayod
= *Agaricus tener* Schaeff. : Fr. (1)
Ref.: Schulzer 1882 a (1), Schulzer *& al.* 1866 (1), Tortić 1968 b
Exs.: CNF

Family **Coprinaceae** Overeem

Coprinus Pers.

(Lit.: Arnolds *& al.* 1995, Bollmann *& al.* 1996, Citerin 1992, Enderle & Bender 1990, Enderle *& al.* 1986, Fries 1821, Hansen & Knudsen 1992, Kreisel 1987, Moser 1983, Singer 1986)

•***Coprinus atramentarius*** (Bull. : Fr.) Fr.
= *Agaricus atramentarius* Bull. : Fr. (1)
Ref.: Schulzer 1857 (1), Schulzer *& al.* 1866, Škorić 1928, Tortić 1964, Tortić 1966 a, Tortić 1966 b, Vouk & Pevalek 1915, unp. Matočec, unp. Mešić & Tkalčec, unp. Tortić
Exs.: CNF
(Lit.: Citerin 1992, Moser 1983)

Coprinus cinereus (Schaeff. : Fr.) Gray
= *Agaricus cinereus* Schaeff. : Fr. (1)
Ref.: Focht 1986, Schulzer *& al.* 1866, Schulzer 1857 HR? (1)

•***Coprinus comatus*** (O.F. Müll. : Fr.) Pers.
= *Agaricus comatus* O.F. Müll. : Fr. (1)
= *Agaricus comatus* O.F. Müll. : Fr. var. *ovatus* (Schaeff. : Fr.) Fr. (2)
Ref.: Blagaić 1921, Blagaić 1931, Focht 1979, Kranjčev 1995, Tortić 1964, Tortić 1966 a, Tortić 1966 b, unp. Matočec, unp. Mešić & Tkalčec, unp. Tortić, Schulzer 1857 HR? (1)(2)
Exs.: BEO, CNF
(Lit.: Citerin 1992, Moser 1983)

•***Coprinus disseminatus*** (Pers. : Fr.) Gray
= *Agaricus disseminatus* Pers. : Fr. (1)
Ref.: Blagaić 1921, Jelić & Tortić 1973, Lisiewska & Tortić 1990, Schulzer 1882 a (1), Schulzer *& al.* 1866 (1), Tortić 1968 b, Tortić 1989, Tortić 1993, unp. Matočec, unp. Mešić & Tkalčec, unp. Tortić, Schulzer 1857 HR? (1)
Exs.: CNF
(Lit.: Citerin 1992, Moser 1983)

Coprinus domesticus (Bolton : Fr.) Gray
Ref.: Vouk & Pevalek 1916

Coprinus ephemerus (Bull. : Fr.) Fr.
Ref.: Focht 1974, Vouk & Pevalek 1916

Coprinus flocculosus (DC. : Fr.) Fr.
Ref.: Focht 1974

Coprinus lagopus (Fr. : Fr.) Fr.
Ref.: Škorić 1928

•***Coprinus micaceus*** (Bull. : Fr.) Fr.
= *Agaricus micaceus* Bull. : Fr. (1)
Ref.: Barčić 1982, Barčić 1996, Gjurašin 1898, Jelić & Tortić 1973, Škorić 1928, Tortić 1964, Tortić 1966 a, Tortić 1966 b, Tortić 1989, Tortić 1993, Vouk & Pevalek 1915, unp. Mešić & Tkalčec, unp. Tortić, Schulzer 1857 HR? (1)
Exs.: CNF
(Lit.: Citerin 1992, Moser 1983)

Coprinus miser P. Karst.
Ref.: Focht 1974

Coprinus niveus (Pers. : Fr.) Fr.
Ref.: Tortić 1964, unp. Tortić
Exs.: CNF

•***Coprinus picaceus*** (Bull. : Fr.) Gray
Ref.: Schulzer *& al.* 1866, Vrščaj 1990, unp. Matočec, unp. Mešić & Tkalčec
Exs.: CNF
(Lit.: Citerin 1992, Moser 1983)

Coprinus plicatilis (Curtis : Fr.) Fr.
Ref.: Blagaić 1921, Schulzer *& al.* 1866, Vouk & Pevalek 1915, Vouk & Pevalek 1916

Coprinus radiatus (Bolton : Fr.) Pers.
Ref.: Schulzer *& al.* 1866

Coprinus romagnesianus Singer
= *Coprinus atramentarius* (Bull. : Fr.) Fr. var. *squamosus* Bres. (1)
Ref.: Kranjčev 1987 (1)

Coprinus strossmayeri Schulzer
Ref.: Schulzer 1879 a

*•***Coprinus truncorum*** (Scop.) Fr.
= *Agaricus micaceus* Bull. : Fr. var. *truncorum* (Scop. : Fr.) Fr. (1)
Ref.: unp. Mešić & Tkalčec, Schulzer 1857 HR? (1)
Exs.: CNF
(Lit.: Citerin 1992, Moser 1983)

Lacrymaria Pat.

(Lit.: Arnolds *& al.* 1995, Hansen & Knudsen 1992, Kreisel 1987, Moser 1983, Singer 1986, Watling & Gregory 1987)

•***Lacrymaria lacrymabunda*** (Bull. : Fr.) Pat.
= *Psathyrella lacrymabunda* (Bull. : Fr.) Moser (1)
= *Lacrymaria velutina* (Pers. : Fr.) Konrad et Maubl. (2)
= *Psathyrella velutina* (Pers. : Fr.) Singer (3)
Ref.: Barčić 1982 (3), Barčić 1996 (3), Tortić 1964 (3), unp. Matočec (1)(3), unp. Mešić & Tkalčec, unp. Tortić (2)(3)
Exs.: CNF
(Lit.: Hansen & Knudsen 1992, Watling & Gregory 1987)

**Panaeolina* Maire

(Lit.: Arnolds *& al.* 1995, Gerhardt 1996, Hansen & Knudsen 1992, Kreisel 1987, Singer 1986, Watling & Gregory 1987)

*•**Panaeolina foenisecii** (Pers. : Fr.) Maire
= *Panaeolus foenisecii* (Pers. : Fr.) J. Schröt.
Ref.: unp. Mešić & Tkalčec
Exs.: CNF
(Lit.: Gerhardt 1996, Moser 1983, Watling & Gregory 1987)

Panaeolus (Fr.) Quél.
= *Anellaria* P. Karst.

(Lit.: Arnolds *& al.* 1995, Gerhardt 1996, Hansen & Knudsen 1992, Kreisel 1987, Moser 1983, Singer 1986, Watling & Gregory 1987)

•***Panaeolus acuminatus*** (Schaeff.) Gillet
= *Agaricus graciloides* Schulzer (1)
= *Agaricus graciloides* Schulzer var. *fraterculus* Schulzer (2)
= *Panaeolus queletii* Schulzer (nom. illeg.) (3)
= *Panaeolus queletii* Schulzer var. *fraterculus* (Schulzer) Schulzer (nom. illeg.) (4)
= *Panaeolus rickenii* Hora
Ref.: Focht 1974, Schulzer 1877 (1)(2), Schulzer 1885 (3)(4), unp. Mešić & Tkalčec, Saccardo 1887 HR? (3)(4)
Exs.: CNF
(Lit.: Gerhardt 1996)

•***Panaeolus papilionaceus*** (Bull. : Fr.) Quél.
= *Agaricus papilionaceus* Bull. : Fr. (1)
= *Chalymmota papilionacea* (Bull. : Fr.) P. Karst. (2)
= *Chalymmota campanulata* (Fr. : Fr.) P. Karst. (3)
= *Panaeolus campanulatus* (Fr. : Fr.) Quél. (non L.) (4)
= *Panaeolus retirugis* (Fr.) Gillet
= *Panaeolus sphinctrinus* (Fr.) Quél. (5)
= *Panaeolus campanulatus* (Fr. : Fr.) Quél. var. *sphinctrinus* (Fr.) Quél. (6)
Ref.: Barčić 1982 (5), Barčić 1984 (5), Barčić 1996 (5), Focht 1972 ( )(4), Focht 1974 (4)(5)(6), Schulzer *& al.* 1866 (1), Škorić 1928 (2)(3), Tortić 1968 b ( )(4), Vouk & Pevalek 1916 (2), unp. Mešić & Tkalčec, unp. Tortić ( )(4), Schulzer 1857 HR? (1)
Exs.: CNF
(Lit.: Gerhardt 1996, Watling & Gregory 1987)

Panaeolus semiovatus (Sowerby : Fr.) S. Lundell

var. ***semiovatus***
= *Anellaria semiovata* (Sowerby : Fr.) A. Pearson et Dennis (1)
= *Agaricus blandus* Schulzer (2)
= *Anellaria separata* (L.) P. Karst. (3)

Misappl.: *Panaeolus fimiputris* (Bull. : Fr.) Quél. sensu auct. non Bull. (4)
(sensu Bull. = nom. dub. - Gerhardt 1996)
Ref.: Gjurašin 1898 (4), Lange 1974 (1), Schulzer 1877 (2), Škorić 1928 (3), unp. Tortić (1)
Exs.: CNF

var. ***phalaenarum*** (Fr.) Ew. Gerhardt
= *Panaeolus phalaenarum* (Fr.) Quél. (5)
Ref.: Blagaić 1921 (5)

Psathyrella (Fr.) Quél.

(Lit.: Arnolds *& al.* 1995, Bollmann *& al.* 1996, Dennis *& al.* 1960, Hansen & Knudsen 1992, Kits van Waveren 1985, Kreisel 1987, Moser 1983, Singer 1986)

•***Psathyrella candolleana*** (Fr. : Fr.) Maire
= *Hypholoma candolleanum* (Fr. : Fr.) Quél. (1)
= *Agaricus appendiculatus* Bull. (2)
= *Psathyrella coronata* (Fr. → P. Karst.) Moser (comb. inval.) (3)
= *Psathyrella microlepidota* P.D. Orton
Ref.: Barčić 1982, Barčić 1996, Blagaić 1921 (1), Focht 1974 ( )(3), Lisiewska & Tortić 1990, Schulzer 1882 a (2), Schulzer *& al.* 1866 (2), Tortić 1966 a, Tortić 1966 b, Tortić 1968 b, Tortić 1989, Tortić 1993, unp. Lisiewska, unp. Mešić & Tkalčec, unp. Tortić
Exs.: CNF, POZM
(Lit.: Kits van Waveren 1985)

Psathyrella cernua (Vahl : Fr.) G. Hirsch
= *Pratella cernua* (Vahl : Fr.) Kirchn. et Eichler (1)
Ref.: Škorić 1928 (1)

Psathyrella conopilus (Fr. : Fr.) A. Pearson et Dennis
= *Coprinarius conopilus* (Fr. : Fr.) J. Schröt. (1)
= *Psathyrella subatrata* (Batsch) Gillet
Ref.: Škorić 1928 (1)

Psathyrella corrugis (Pers. : Fr.) Konrad et Maubl.
= *Agaricus corrugis* Pers. : Fr. (1)
= *Pratella corrugis* (Pers. : Fr.) ? (2)
= *Coprinarius gracilis* (Fr. : Fr.) P. Kumm. (3)
= *Psathyrella gracilis* (Fr. : Fr.) Quél. (4)
Ref.: Schulzer *& al.* 1866 (1), Vouk & Pevalek 1915 (3), Vouk & Pevalek 1916 (2)(3), unp. Tortić (4)
Exs.: CNF

*•***Psathyrella cotonea*** (Quél.) Konrad et Maubl.
Ref.: unp. Mešić & Tkalčec

Exs.: CNF
(Lit.: Kits van Waveren 1985)

Psathyrella fusca (Schumach. → J.E. Lange) A. Pearson
Ref.: Focht 1974

•**Psathyrella leucotephra** (Berk. et Broome) P.D. Orton
= *Hypholoma leucotephrum* (Berk. et Broome) Sacc. (1)
Misappl.: *Psathyrella hypsipus* (Fr.) Konrad et Maubl. sensu auct. non Fr. (2)
(sensu Fr. = nom. dub. - Kits van Waveren 1985)
Ref.: Tortić 1968 b (2), unp. Mešić & Tkalčec, unp. Tortić (2), Blagaić 1921 ? (1)
Exs.: CNF
(Lit.: Kits van Waveren 1985)

Psathyrella maculata (C.S. Parker) A.H. Sm.
Misappl.: *Psathyrella scobinacea* (Fr.) Konrad & Maubl. sensu Moser non Fr.
(sensu Fr. = nom. dub. - Kits van Waveren 1985)
Ref.: Focht 1974, Vrščaj 1990

*__Psathyrella obtusata__ (Pers. : Fr.) A.H. Sm.
= *Psathyra obtusata* (Pers. : Fr.) Gillet (1)
Ref.: unp. Tortić (1)

•**Psathyrella piluliformis** (Bull. : Fr.) P.D. Orton
= *Hypholoma hydrophilum* (Bull.) Quél. (1)
= *Psathyrella hydrophila* (Bull.) Maire (2)
Ref.: Focht 1974 (1), Jelić & Tortić 1973 (2), Lisiewska & Tortić 1990, Tortić 1968 b (2), Tortić & Lisiewska 1978 (2), unp. Mešić & Tkalčec, unp. Tortić (2), Focht 1979 HR? (2)
Exs.: CNF
(Lit.: Kits van Waveren 1985)

Psathyrella sarcocephala (Fr.) Singer
Ref.: Tortić 1968 b, unp. Tortić
Exs.: CNF

•**Psathyrella spadicea** (Schaeff. → P. Kumm.) Singer
= *Pratella spadicea* (Schaeff. → P. Kumm.) J. Schröt. (1)
Ref.: Vouk & Pevalek 1915 (1), unp. Mešić & Tkalčec
Exs.: CNF
(Lit.: Kits van Waveren 1985)

•**Psathyrella spadiceogrisea** (Schaeff.) Maire
= *Psathyra spadiceogrisea* (Schaeff.) P. Kumm. (1)
= *Psathyrella exalbicans* (Romagn.) Bon
= *Psathyrella vernalis* (J.E. Lange) Moser (comb. illeg.) non *P. vernalis* Velen.
Ref.: Tortić 1968 b, unp. Mešić & Tkalčec, unp. Tortić ( )(1)

Exs.: CNF
(Lit.: Kits van Waveren 1985)

Family **Entolomataceae** Kotl. et Pouzar

Clitopilus (Fr.) P. Kumm.

(Lit.: Arnolds *& al.* 1995, Bas *& al.* 1988, Bollmann *& al.* 1996, Hansen & Knudsen 1992, Kreisel 1987, Moser 1983, Singer 1978, Singer 1986, Škorić 1928)

•***Clitopilus prunulus*** (Scop. : Fr.) P. Kumm.
= *Hyporrhodius prunulus* (Scop. : Fr.) Henn. (1)
= *Paxillus prunulus* (Scop. : Fr.) Quél. (2)
= *Agaricus orcellus* Bull. : Fr. (3)
Ref.: Blagaić 1921 (2), Blagaić 1931 (2), Božac 1982, Božac 1984, Božac 1986, Božac 1989, Božac 1993, Focht 1974, Focht 1986, Schulzer 1882 a (3), Schulzer *& al.* 1866 (3), Škorić 1928 (1), Tortić 1964, Tortić 1966 a, Tortić 1966 b, Tortić 1993, Tortić & Lisiewska 1978, Vouk & Pevalek 1916 (1), unp. Lisiewska, unp. Matočec, unp. Mešić & Tkalčec, unp. Tortić, Focht 1979 HR?
Exs.: BEO, CNF, POZM
(Lit.: Bas *& al.* 1988, Hansen & Knudsen 1992, Moser 1983)

*****Clitopilus rhodophyllus*** (Bres.) Singer
Misappl.: *Clitopilus pinsitus* (Fr. : Fr.) Joss. sensu Joss. non Fr. (1)
Ref.: unp. Tortić (1)
Exs.: CNF

•***Clitopilus scyphoides*** (Fr. : Fr.) Singer
= *Clitopilus cretatus* (Berk. et Broome) Sacc. (1)
Ref.: Božac 1984 (1), unp. Mešić & Tkalčec
Exs.: CNF
(Lit.: Bas *& al.* 1988, Hansen & Knudsen 1992, Moser 1983)

Entoloma (Fr.) P. Kumm.

(Lit.: Arnolds *& al.* 1995, Bas *& al.* 1988, Bollmann *& al.* 1996, Dennis *& al.* 1960, Hansen & Knudsen 1992, Kreisel 1987, Moser 1983, Noordeloos 1985, Noordeloos 1992, Singer 1986, Škorić 1928, Vouk & Pevalek 1916)

*****Entoloma bloxamii*** (Berk. et Broome) Sacc.
= *Entoloma madidum* (Fr. →) Gillet
= *Rhodophyllus madidus* (Fr. → Gillet) Quél. (1)
Ref.: unp. Tortić (1)
Exs.: CNF

•***Entoloma clypeatum*** (L.) P. Kumm.
= *Hyporrhodius clypeatus* (L.) J. Schröt. (1)

= *Rhodophyllus clypeatus* (L.) Quél. (2)
Ref.: Blagaić 1931, Focht 1979 (2), Kranjčev 1995, Tortić 1964 (2), Vouk & Pevalek 1916 (1), unp. Mešić & Tkalčec, unp. Tortić
Exs.: CNF
(Lit.: Bas *& al.* 1988, Noordeloos 1992)

*•***Entoloma conferendum*** (Britzelm.) Noordel.

*•var. ***conferendum***
= *Rhodophyllus staurosporus* (Bres.) J.E. Lange (1)
Ref.: unp. Matočec (1), unp. Mešić & Tkalčec
Exs.: CNF
(Lit.: Bas *& al.* 1988, Noordeloos 1992)

Entoloma corvinum (Kühner) Noordel.
= *Rhodophyllus corvinus* Kühner (1)
Ref.: Tortić 1973 (1)
Exs.: PRM (1)

Entoloma exile (Fr. : Fr.) Hesler
= *Entoloma pyrospilum* (Romagn. ex P.D. Orton) Moser
= *Rhodophyllus pyrospilus* Romagn. (nom. inval.) (1)
Ref.: Tortić 1973 (1), unp. Matočec
Exs.: CNF, PRM (1)

*•***Entoloma fernandae*** (Romagn.) Noordel.
= *Entoloma psilopus* Arnolds et Noordel.
Ref.: unp. Mešić & Tkalčec
Exs.: CNF
(Lit.: Bas *& al.* 1988, Noordeloos 1992)

Entoloma hirtipes (Schumach. : Fr.) Moser
= *Nolanea hirtipes* (Schumach. : Fr.) P. Kumm. (1)
= *Rhodophyllus hirtipes* (Schumach. : Fr.) Quél. (2)
Ref.: Barčić 1989, Barčić 1996, Tortić 1966 a (2), Tortić 1966 b (2), Tortić 1968 a (1), unp. Tortić (1)(2)
Exs.: CNF

•***Entoloma incanum*** (Fr. : Fr.) Hesler
= *Leptonia incana* (Fr. : Fr.) Gillet (1)
= *Rhodophyllus incanus* (Fr. : Fr.) Kühner et Romagn. (comb. inval.) (2)
Ref.: Jaap 1916 (1), Lisiewska & Tortić 1990, Tortić 1973 (2), unp. Lisiewska, unp. Mešić & Tkalčec, unp. Tortić (2)
Exs.: CNF, POZM, PRM (2)
(Lit.: Bas *& al.* 1988, Noordeloos 1992)

Entoloma lividoalbum (Kühner et Romagn.) Kubička
Ref.: Barčić 1982, Barčić 1996

•***Entoloma mougeotii*** (Fr.) Hesler
= *Hyporrhodius mougeotii* (Fr.) Henn. (1)

= *Rhodophyllus mougeotii* (Fr.) J.E. Lange (2)
Misappl.: *Rhodophyllus ardosiacus* (Bull. : Fr.) Quél. sensu auct. non Bull. (3)
Ref.: Focht 1974 (2), Tortić 1966 a (3), Tortić 1966 b (3), Vouk & Pevalek 1915 (1), Vouk & Pevalek 1916 (1), unp. Mešić & Tkalčec, unp. Tortić (3)
Exs.: CNF
(Lit.: Bas *& al.* 1988, Noordeloos 1992)

Entoloma plebeioides (Schulzer) Noordel.
= *Agaricus plebeioides* Schulzer (1)
= *Entoloma holophaeum* Bres. et Schulzer (nom. illeg.) (2)
Ref.: Saccardo 1887 (2), Schulzer 1877 (1), Schulzer 1885 (2)

Entoloma pleopodium (Bull. ex DC. : Fr.) Noordel.
= *Entoloma icterinum* (Fr. : Fr.) Moser
= *Rhodophyllus icterinus* (Fr. : Fr.) Quél. (1)
Ref.: Tortić 1966 a (1), Tortić 1966 b (1), unp. Tortić (1)
Exs.: CNF

Entoloma politum (Pers. : Fr.) Donk
= *Hyporrhodius politus* (Pers. : Fr.) Henn. (1)
Ref.: Vouk & Pevalek 1916 (1)

*•***Entoloma porphyrophaeum*** (Fr.) P. Karst.
= *Rhodophyllus porphyrophaeus* (Fr.) J.E. Lange (1)
Ref.: unp. Mešić & Tkalčec, unp. Tortić (1)
Exs.: CNF
(Lit.: Bas *& al.* 1988, Noordeloos 1992)

Entoloma prunuloides (Fr. : Fr.) Quél.
Ref.: Blagaić 1923

•***Entoloma rhodopolium*** (Fr. : Fr.) P. Kumm.
Ref.: Barčić 1996

•var. ***rhodopolium***
= *Agaricus rhodopolius* Fr. : Fr. (1)
= *Rhodophyllus rhodopolius* (Fr. : Fr.) Quél. (2)
Ref.: Barčić 1982 (as *E. rhodopolium*), Focht 1979 (2), unp. Mešić & Tkalčec, Schulzer 1857 HR? (1)
Exs.: CNF
(Lit.: Noordeloos 1992)

var. ***nidorosum*** (Fr.) Krieglst.
= *Entoloma nidorosum* (Fr.) Quél. (3)
= *Rhodophyllus nidorosus* (Fr.) Quél. (4)
Ref.: Focht 1979 (4), Kišpatić 1950 (3), Mužic & Božac 1997 (4), Tortić 1973 (4), Tortić & Lisiewska 1978 (4), unp. Tortić (3)(4)
Exs.: CNF

Entoloma sepium (Noulet et Dass.) Richon et Roze
= *Rhodophyllus sepius* (Noulet et Dass.) Romagn. (1)
= *Agaricus prunarii* Schulzer (2)
Ref.: Focht 1979 (1), Schulzer 1880 (2), Schulzer *& al.* 1866 (nom. nud.) (2)

•***Entoloma sericellum*** (Fr. : Fr.) P. Kumm.
= *Rhodophyllus sericellus* (Fr. : Fr.) Quél. (1)
= *Agaricus carneoalbus* With. (2)
Ref.: Kalchbrenner & Schulzer 1873-1877 (2), Tortić 1973 (1), unp. Mešić & Tkalčec
Exs.: CNF, PRM (1)
(Lit.: Bas *& al.* 1998, Noordeloos 1992)

*•***Entoloma serrulatum*** (Fr. : Fr.) Hesler
Ref.: unp. Lisiewska, unp. Mešić & Tkalčec, unp. Tortić
Exs.: CNF, POZM
(Lit.: Bas *& al.* 1988, Noordeloos 1992)

•***Entoloma sinuatum*** (Bull. ex Pers. : Fr.) P. Kumm.
= *Rhodophyllus sinuatus* (Bull. ex Pers. : Fr.) Quél. (1)
= *Entoloma eulividum* Noordel.
Misappl.: *Entoloma lividum* (Bull.) Quél. sensu auct. non Bull. (2)
(sensu Bull. = *Pluteus cervinus* (Schaeff.) P. Kumm. - Noordeloos 1992)
Misappl.: *Hyporrhodius lividus* (Bull.) J. Schröt. sensu auct. non Bull. (3)
Misappl.: *Rhodophyllus lividus* (Bull.) Quél. sensu auct. non Bull. (4)
Ref.: Barčić 1982, Barčić 1996, Blagaić 1923 (2), Blagaić 1931 (2), Focht 1979 (4), Focht 1986 (4), Mužic & Božac 1997, Škorić 1928 (3), Tortić 1964 (1), Tortić & Lisiewska 1978 (1), Vrščaj 1990, unp. Matočec (2), unp. Mešić & Tkalčec, unp. Tortić (1)(2)
Exs.: CNF
(Lit.: Bas *& al.* 1988, Noordeloos 1992)

Rhodocybe Maire

(Lit.: Arnolds *& al.* 1995, Bas *& al.* 1988, Bollmann *& al.* 1996, Hansen & Knudsen 1992, Kreisel 1987, Moser 1983, Singer 1986)

Rhodocybe fallax (Quél.) Singer
= *Clitopilopsis fallax* (Quél.) Kühner ex Konrad et Maubl. (1)
Ref.: Tortić 1968 b (1), unp. Tortić (1)
Exs.: CNF

•***Rhodocybe gemina*** (Fr.) Kuyper et Noordel.
Misappl.: *Rhodocybe truncata* (Schaeff.) Singer sensu auct. non Schaeff. (1)

Ref.: Božac 1984 (1), Božac 1986 (1), Božac 1989 (1), Božac 1993 (1), Focht 1974 (1), Vrščaj 1990, unp. Matočec (1), unp. Mešić & Tkalčec
Exs.: CNF
(Lit.: Bas *& al.* 1988, Hansen & Knudsen 1992)

Rhodocybe parilis (Fr. : Fr.) Singer
= *Clitocybe parilis* (Fr. : Fr.) Gillet (1)
Ref.: Focht 1974 (1)

*•***Rhodocybe popinalis*** (Fr. : Fr.) Singer
= *Rhodocybe mundula* (Lasch : Fr.) Singer (1)
Ref.: unp. Mešić & Tkalčec, unp. Tortić (1)
Exs.: CNF
(Lit.: Bas *& al.* 1988, Hansen & Knudsen 1992, Moser 1983)

Family **Pluteaceae** Roze ex Kotl. et Pouzar

Pluteus Fr.

(Lit.: Arnolds *& al.* 1995, Banerjee & Sundberg 1995, Bas *& al.* 1990, Bollmann *& al.* 1996, Fries 1821, Hansen & Knudsen 1992, Kreisel 1987, Moser 1983, Orton 1986, Singer 1986, Škorić 1928)

•***Pluteus atromarginatus*** (Singer) Kühner
= *Pluteus tricuspidatus* Velen. (1)
Ref.: Focht 1972, Focht 1974, Lisiewska & Tortić 1990 (1), Tortić 1966 a, Tortić 1966 b, Tortić 1989, Tortić 1993, unp. Mešić & Tkalčec, unp. Tortić, Focht 1979 HR?
Exs.: CNF
(Lit.: Bas *& al.* 1990, Orton 1986)

•***Pluteus cervinus*** (Schaeff.) P. Kumm.
= *Agaricus cervinus* Schaeff. (1)
= *Hyporrhodius cervinus* (Schaeff.) Henn. (2)
= *Pluteus atricapillus* (Batsch) Fayod (3)
= *Agaricus pluteus* Batsch : Fr. (4)
Ref.: Blagaić 1921, Focht 1972, Focht 1974, Focht 1979, Jelić & Tortić 1973 (3), Schulzer 1882 a (1), Schulzer *& al.* 1866 (1), Škorić 1928 (2), Tortić 1962, Tortić 1964, Tortić 1966 a, Tortić 1966 b, Tortić 1989 (3), Vouk & Pevalek 1916 (2), unp. Matočec (3), unp. Mešić & Tkalčec, unp. Tortić, Schulzer 1857 HR? (4)
Exs.: CNF
(Lit.: Bas *& al.* 1990, Orton 1986)

Pluteus chrysophaeus (Schaeff.) Quél.
= *Hyporrhodius chrysophaeus* (Schaeff.) Henn. (1)
= *Pluteus galeroides* P.D. Orton
= *Pluteus luteovirens* Rea
= *Pluteus xanthophaeus* P.D. Orton

Ref.: Škorić 1928 (1), Tortić 1966 a, Tortić 1966 b, unp. Tortić
Exs.: CNF

*•**Pluteus exiguus** (Pat.) Sacc.
Ref.: unp. Mešić & Tkalčec
Exs.: CNF
(Lit.: Bas *& al.* 1990, Orton 1986)

***Pluteus inquilinus** Romagn.
= *Pluteus alborugosus* Kühner (nom. inval.) (1)
Misappl.: *Pluteus semibulbosus* (Lasch) Gillet sensu J.E. Lange, P.D. Orton non Lasch
(sensu Lasch = *Pluteus plautus* (Weinm.) Gillet - Bas *& al.* 1990)
Ref.: unp. Lisiewska (1)
Exs.: POZM (1)

•**Pluteus leoninus** (Schaeff. : Fr.) P. Kumm.
Ref.: Tortić 1989, unp. Matočec, unp. Mešić & Tkalčec, unp. Tortić
Exs.: CNF
(Lit.: Bas *& al.* 1990, Orton 1986)

*•**Pluteus pallescens** P.D. Orton
Misappl.: *Pluteus satur* Kühner et Romagn. sensu Romagn, P.D. Orton 1986 non Kühner et Romagn.
(sensu Kühner et Romagn. = *Pluteus nanus* (Pers. : Fr.) P. Kumm. - Bas *& al.* 1990)
Ref.: unp. Mešić & Tkalčec
Exs.: CNF
(Lit.: Bas *& al.* 1990, Orton 1986)

•**Pluteus pellitus** (Pers. : Fr.) P. Kumm.
Ref.: Focht 1979, unp. Mešić & Tkalčec
Exs.: CNF
(Lit.: Bas *& al.* 1990, Hansen & Knudsen 1992, Orton 1986)

•**Pluteus petasatus** (Fr.) Gillet
= *Agaricus patricius* Schulzer (1)
= *Pluteus patricius* (Schulzer) Boud. (2)
Misappl.: *Pluteus curtisii* (Berk. et Broome) Sacc. sensu Moser non Berk. et Broome
(sensu Berk. et Broome = *Pluteus cervinus* (Schaeff.) P. Kumm. - Bas *& al.* 1990)
Ref.: Blagaić 1921 (2), Focht 1979 (2), Kalchbrenner & Schulzer 1873--1877 (1), Tortić 1968 b, Tortić 1973, unp. Mešić & Tkalčec, unp. Tortić, Fries 1874 HR? (1), Saccardo 1887 HR? (2)
Exs.: CNF
(Lit.: Bas *& al.* 1990, Orton 1986)

Pluteus phlebophorus (Ditmar : Fr.) P. Kumm.
= *Agaricus phlebophorus* Ditmar : Fr. (1)
Ref.: Schulzer *& al.* 1866 (1), Tortić 1989, unp. Tortić, Schulzer 1857 HR? (1)
Exs.: CNF

•***Pluteus plautus*** (Weinm.) Gillet
= *Pluteus boudieri* P.D. Orton
= *Pluteus depauperatus* Romagn.
= *Pluteus dryophiloides* P.D. Orton
= *Pluteus gracilis* (Bres.) J.E. Lange (1)
= *Pluteus pellitus* (Pers. : Fr.) P. Kumm. var. *gracilis* Bres. (2)
= *Pluteus granulatus* Bres.
= *Pluteus punctipes* P.D. Orton
= *Pluteus semibulbosus* (Lasch) Gillet
Ref.: Focht 1974 (1), Schulzer 1885 (2), unp. Mešić & Tkalčec, Saccardo 1887 HR? (2)
Exs.: CNF
(Lit.: Bas *& al.* 1990, Orton 1986)

*•***Pluteus podospileus*** Sacc. et Cub.
Ref.: unp. Mešić & Tkalčec
Exs.: CNF
(Lit.: Bas *& al.* 1990, Orton 1986)

*•***Pluteus romellii*** (Britzelm.) Lapl.
Ref.: unp. Mešić & Tkalčec
Exs.: CNF
(Lit.: Bas *& al.* 1990, Orton 1986)

•***Pluteus salicinus*** (Pers. : Fr.) P. Kumm.
Ref.: Tortić & Lisiewska 1978, unp. Mešić & Tkalčec, unp. Tortić
Exs.: CNF
(Lit.: Bas *& al.* 1990, Orton 1986)

*•***Pluteus thomsonii*** (Berk. et Broome) Dennis
Ref.: unp. Mešić & Tkalčec
Exs.: CNF
(Lit.: Bas *& al.* 1990, Orton 1986)

Pluteus umbrosus (Pers. : Fr.) P. Kumm.
Ref.: Tortić 1989, unp. Tortić
Exs.: CNF

Volvariella Speg.

(Lit.: Arnolds *& al.* 1995, Bas *& al.* 1990, Boekhout 1986, Bollmann *& al.* 1996, Hansen & Knudsen 1992, Kreisel 1987, Moser 1983, Orton 1986, Singer 1986)

•***Volvariella bombycina*** (Schaeff. : Fr.) Singer
= *Agaricus bombycinus* Schaeff. : Fr. (1)
= *Volvaria bombycina* (Schaeff. : Fr.) P. Kumm. (2)
Ref.: Blagaić 1931 (2), Božac 1982, Božac 1984, Božac 1989, Božac 1993, Focht 1986, Lange 1974, Schulzer *& al.* 1866 (1), Tortić 1968 b, unp. Matočec, unp. Mešić & Tkalčec, unp. Tortić (2)
Exs.: CNF
(Lit.: Bas *& al.* 1990, Orton 1986)

•***Volvariella gloiocephala*** (DC. : Fr.) Boekhout et Enderle
= *Volvaria gloiocephala* (DC. : Fr.) Gillet (1)
= *Volvaria speciosa* (Fr. : Fr.) P. Kumm. f. *gloiocephala* (DC. : Fr.) Konrad et Maubl. (2)
= *Volvariella speciosa* (Fr. : Fr.) Singer var. *gloiocephala* (DC. : Fr.) Singer (3)
= *Agaricus speciosus* Fr. : Fr. (4)
= *Volvariella speciosa* (Fr. : Fr.) Singer var. *speciosa* (5)
Ref.: Focht 1986 (3)(5), Schulzer *& al.* 1866 (4), Tortić 1964, Tortić 1966 a (1), unp. Mešić & Tkalčec, unp. Tortić ( )(1)(2), Schulzer 1857 HR? (4)
Exs.: CNF
(Lit.: Bas *& al.* 1990, Moser 1983)

*•***Volvariella hypopithys*** (Fr.) Shaffer
= *Volvariella pubescentipes* (Peck) Singer
Ref.: unp. Mešić & Tkalčec
Exs.: CNF
(Lit.: Bas *& al.* 1990, Hansen & Knudsen 1992, Orton 1986)

*•***Volvariella murinella*** (Quél.) Courtec.
Ref.: unp. Mešić & Tkalčec
Exs.: CNF
(Lit.: Bas *& al.* 1990, Orton 1986)

Volvariella pusilla (Pers. : Fr.) Singer
= *Volvariella parvula* (Weinm.) Speg.
Ref.: Focht 1986, unp. Matočec
Exs.: CNF

•***Volvariella surrecta*** (Knapp) Singer
Ref.: Focht 1986, unp. Mešić & Tkalčec
Exs.: CNF
(Lit.: Bas *& al.* 1990, Orton 1986)

Volvariella volvacea (Bull. : Fr.) Singer
= *Volvaria volvacea* (Bull. : Fr.) P. Kumm. (1)
Ref.: Tortić 1964, Vouk & Pevalek 1916 (1), unp. Tortić (1)

EXCLUDED RECORDS

Family **Bolbitiaceae** Singer

Agaricus pediades Fr. : Fr.
= ! *Agaricus arvalis* Fr. : Fr.
Ref.: Schulzer 1879 b HR?
Annotation: We exclude this record due to incorrect synonymy.

Agaricus pusiolus Fr. : Fr. var. ***major*** Schulzer = **?**
Ref.: Schulzer 1878

Bolbitius ozonii Schulzer = **?**
Ref.: Saccardo 1887, Schulzer 1883 a, Schulzer 1883 b

Galera tenera (Schaeff. : Fr.) P. Kumm. var. ***hyalopoda*** Bres. = **?**
Ref.: Schulzer 1885, Saccardo 1887 HR?

Family **Coprinaceae** Overeem

Agaricus biformis Schulzer = **?** [*Psathyrella*]
Ref.: Schulzer 1878

Agaricus cascus Fr. var. ***stipite-brevi*** Schulzer = **?**
Ref.: Schulzer 1878

Agaricus cernuus Vahl : Fr. var. ***perforatus*** Schulzer = **?**
Ref.: Schulzer 1880

Agaricus costatulus Schulzer = **?** [*Panaeolus*]
Ref.: Schulzer 1880

Agaricus eremita Schulzer = **?** [*Psathyrella*]
Ref.: Schulzer 1881

Agaricus flaccescens Schulzer = **?**
= *Psathyra schulzeri* Quél. (nom. illeg.) (1)
Ref.: Schulzer 1877, Schulzer 1885 (1), Saccardo 1887 HR? (1)

Agaricus gracilis Pers. var. ***medius*** Schulzer = **?** [*Psathyrella*]
Ref.: Schulzer 1878

Agaricus helvolus Schaeff. - nom. dub. (Gerhardt 1996)
Ref.: Schulzer 1857 HR?

Agaricus semiglobularis Schulzer = **?** [*Panaeolus*]
Ref.: Schulzer 1881

Agaricus serotinellus Schulzer = **?** [*Psathyrella*]
Ref.: Schulzer 1882 b

Agaricus subaurantius Schulzer = **?** [*Psathyrella*]
Ref.: Schulzer 1877

Agaricus subcernuus Schulzer - nom. dub. (Kits van Waveren 1985)
Ref.: Schulzer 1877

Agaricus subfasciolatus Schulzer = **?** [*Panaeolus*]
Ref.: Schulzer 1880

Agaricus subtilis Fr. : Fr. var. ***hortensis*** Schulzer = **?** [*Psathyrella*]
Ref.: Schulzer 1877

Agaricus tenebricosus Schulzer = **?** [*Psathyrella*]
Ref.: Schulzer 1882 b

Chalymmota macrocystis Vouk et Pevalek = **?**
Ref.: Vouk & Pevalek 1915, Vouk & Pevalek 1916

Coprinarius deparculus Britzelm. = **?**
Ref.: Škorić 1928

Coprinus bresadolae Schulzer = **?**
Ref.: Schulzer 1885, Saccardo 1887 HR?

Coprinus laxus Bres. et Schulzer = **?**
Ref.: Schulzer 1885, Saccardo 1887 HR?

Coprinus micaceus (Bull. : Fr.) Fr. var. ***congregatus*** Rabenh. = **?**
Ref.: Schulzer *& al.* 1866

Coprinus papillatus (Batsch : Fr.) Fr. = **?**
Ref.: Vouk & Pevalek 1916
Annotation: Enderle *& al.* (1986) consider that it could be identical with *Coprinus patouillardii* Quél.

Coprinus porcellanus Schaeff. = **?**
Ref.: Vouk & Pevalek 1915, Vouk & Pevalek 1916

Coprinus queletii Schulzer = **?**
Ref.: Schulzer 1885, Saccardo 1887 HR?

Coprinus roris Quél. = **?**
Ref.: Schulzer 1885

Coprinus subcoeruleogriseus Schulzer = **?**
Ref.: Schulzer 1879 a

Panaeolus lerchenfeldii (Schulzer) Sacc.
Ref.: Saccardo 1887
Annotation: Author of the record specified Slavonia (part of Croatia today) as a locality, but Schulzer found the species in the part of former Slavonia that nowadays does not belong to Croatia.

Psathyra torpens (Fr. : Fr.) Quél. var. ***atrospora*** Quél. = **?**
Ref.: Saccardo 1887, Schulzer 1885

Psathyrella asperella Quél. et Schulzer = **?**
Ref.: Schulzer 1885

Family **Entolomataceae** Kotl. et Pouzar

Agaricus fumosoalbus Schulzer = **?** [*Entoloma*]
Ref.: Schulzer 1879 a

Agaricus infrequens Schulzer = **?** [*Entoloma*]
Ref.: Schulzer 1878

Agaricus lazulinoides Schulzer = **?**
= *Leptonia bresadolae* Schulzer (nom. illeg.) (1)
Ref.: Schulzer 1878, Schulzer 1885 (1)

Agaricus majalis Fr. : Fr. var. ***furvescens*** Schulzer = **?** [*Entoloma*]
Ref.: Schulzer 1877

Agaricus melancholicus Schulzer = **?** [*Eccilia*]
Ref.: Schulzer 1877

Agaricus nigrocinnamomeus Schulzer var. ***nemoreus*** Schulzer = **?** [*Entoloma*]
Ref.: Schulzer 1878

Agaricus pascuus Pers. : Fr.
Ref.: Schulzer 1867
Annotation: Pilát (1951) considers this name a synonym of *Entoloma sericeum* (Bull. →) Quél., whereas Dennis *& al.* (1960) consider it a nomen confusum.

Agaricus poetschii Schulzer = **?** [*Leptonia*]
Ref.: Schulzer 1881

Agaricus recedens Schulzer = **?** [*Entoloma*]
Ref.: Schulzer 1877

Agaricus umbrinoalbus Schulzer = **?** [*Eccilia*]
Ref.: Schulzer 1880

Hyporrhodius dissentiens Britzelm. = **?**
Ref.: Vouk & Pevalek 1916

Hyporrhodius mammosus (L.) ?
Ref.: Vouk & Pevalek 1915
Annotation: We exclude this record due to numerous misapplications of the epithet (see Dennis *& al.* 1960, Noordeloos 1992).

Hyporrhodius nidus-avis (Secr.) Henn. = **?**
Ref.: Škorić 1928

Rhodophyllus griseorubellus (Lasch : Fr.) Quél.
Ref.: Focht 1974
Annotation: This species has been interpreted in different senses (see Dennis *& al.* 1960, Noordeloos 1992). We do not know which sense has been used by the author of the record.

Rhodophyllus placenta (Batsch) ? = **?**
= ! *Rhodophyllus aprilis* (Britzelm.) Romagn.
Ref.: Focht 1979
Annotation: In the literature available to us we could not find the confirmation of the synonymy given by Focht (1979), so we exclude the record.

Family **Pluteaceae** Roze ex Kotl. et Pouzar

Agaricus albidofumosus Schulzer = **?** [*Pluteus*]
Ref.: Schulzer 1877

Agaricus albovirgatus Schulzer = **?** [*Pluteus*]
Ref.: Schulzer 1880

Agaricus caespitosulus Schulzer = **?** [*Pluteus*]
Ref.: Schulzer 1880

Agaricus cervinus Schaeff. var. ***albicans*** Schulzer - nom. nud.
Ref.: Schulzer *& al.* 1866

Agaricus chrysophaeoides Schulzer = **?** [*Pluteus*]
Ref.: Schulzer 1878

Agaricus niveipes Schulzer = **?** [*Pluteus*]
Ref.: Schulzer 1877

Agaricus ochropilus Schulzer - nom. nud.
= *Agaricus bombycinus* Schaeff. : Fr. var. *ochropilus* Schulzer (nom. nud.) (1)
Ref.: Schulzer *& al.* 1866 (1) + Schulzer 1867

Agaricus patricius Schulzer var. ***carpini*** Schulzer = **?**
Ref.: Schulzer 1878

Agaricus soricinoides Schulzer = **?** [*Pluteus*]
Ref.: Schulzer 1877

Agaricus subalbicans Schulzer = **?** [*Pluteus*]
Ref.: Schulzer 1881

Agaricus subspeciosus Schulzer = **?** [*Volvaria*]
Ref.: Schulzer 1880

Agaricus virgatorumpens Schulzer = **?** [*Pluteus*]
Ref.: Schulzer 1877

Amanita bresadolae Schulzer = *Volvariella* sp. (Gilbert 1940-1941)
= *Amanitopsis bresadolae* (Schulzer) Sacc. (1)
Ref.: Saccardo 1887 (1), Schulzer 1885

Chamaeota fenzlii (Schulzer) Singer
= *Annularia fenzlii* (Schulzer) Gillet (1)
Ref.: Saccardo 1887 (1)
Annotation: The author of the record specified Slavonia (part of Croatia today) as a locality, but Schulzer found the species in the part of former Slavonia that nowadays does not belong to Croatia (see Kalchbrenner & Schulzer 1873-1877).

Pluteus drepanophyllus (Schulzer) Schulzer
= *Agaricus drepanophyllus* Schulzer (1)
= *Pluteus creatophyllus* Sacc. (2)
Ref.: Kalchbrenner & Schulzer 1873-1877 (1), Saccardo 1887 HR? (2)

Annotation: Singer (1986) considers it an autonomous species, while Bas *& al.* (1990) consider that Singer has misapplied this name to *Pluteus ephebeus* (Fr. : Fr.) Gillet. Bas *& al.* (1990) do not specify what *P. drepanophyllus* is in the original, Schulzer's sense.

Pluteus drepanophyllus (Schulzer) Schulzer var. ***excoriatus*** Bres. = ?
= *Pluteus creatophyllus* Sacc. var. *excoriatus* (Bres.) Sacc. (1)
= *Agaricus pluteiformis* Schulzer (2)
Ref.: Schulzer 1880 (2), Schulzer 1885, Saccardo 1887 HR? (1)

Pluteus pellitus (Pers. : Fr.) P. Kumm. var. ***punctillifer*** Quél. = ?
Ref.: Saccardo 1887, Schulzer 1885

Pluteus robertii (Fr.) P. Karst.
Ref.: Focht 1974
Annotation: This species has been interpreted in a few different senses (see Bas *& al.* 1990, Dennis *& al.* 1960, Orton 1986). We do not know which sense has been used by the author of the record.

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LACTARIUS FURCATUS IN MEXICO AND COSTA RICA

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ABSTRACT

Fresh collections of *Lactarius furcatus* were gathered in Mexico and Costa Rica. The type specimen from United States (North Carolina) apparently is lost. A specimen from Tennessee, U.S.A., determined as *Lactarius furcatus* by A. H. Smith and kept at MICH was also studied. A description and discussion, based on recent collections, including illustrations of macro and microscopic features, are presented.

Keywords: Russulaceae, taxonomy, ectomycorrhizal fungi, *Lactarius* subg. *Piperites*

INTRODUCTION

Among the ectomycorrhizal mushrooms found in North America, *Lactarius* is frequently encountered and is a significant component of macromycetes diversity (Hesler and Smith, 1979). The association of the genus with *Quercus* indicates that there are many *Lactarius* species, either broadly or narrowly distributed, in North America. In Mexico, for example, the genus *Quercus* is highly diverse (Rammamorthy *et al.* 1993), and provides for a rich *Lactarius* biota. A number of *Lactarius* spp. found in the eastern deciduous forests of the U.S.A. are also distributed in the mesophytic montane forests of Mexico, associated with *Quercus* and some Betulaceae (Montoya 2000).

The presence of populations of *Lactarius* recorded in North and Central America indicate some evidence of host specifity, following trees of North Temperate origin that migrated from north to south. *Quercus oleoides* Schldl. & Cham. and *Q. corrugata* Hook. currently exhibit a tropical and subtropical distribution in Mexico and Costa Rica, and are associated with several *Lactarius* species. *Lactarius furcatus* Coker, originally described from the eastern United States (North Carolina), has been found in Mexico and Costa Rica growing under *Quercus*. This paper describes our observations on recent collections.

MATERIALS AND METHODS

The macroscopic description is based on fresh material. Color codes follow Kornerup and Wanscher (1978). Measurements and colors of the microscopic structures were recorded in 3% KOH, except for the basidiospores, which were studied in Melzer´s reagent. When estimating spore dimensions, part of the recommendations by Heinemann and Rameloo (1985) were used. 25-30 spores per collection were measured (in side view), selected at random from hymenial tissues. The height of the ornamentation was considered separately. **RM** corresponds to the range of means of basidiospore length x width, and **QM** to the range of the mean of Q (length/width ratio). Line drawings were made with the aid of a drawing tube. For scanning electron microscope (SEM) preparations, pieces of lamellae from the dried specimens were rehydrated in ammonia, and afterwards fixed in glutaraldehyde. The pieces were critical point dried in acetone in a Polaron critical point dryer, and sputter-coated with gold. Herbarium acronyms are according to Holmgren *et al.* (1990).

DESCRIPTION OF THE SPECIES

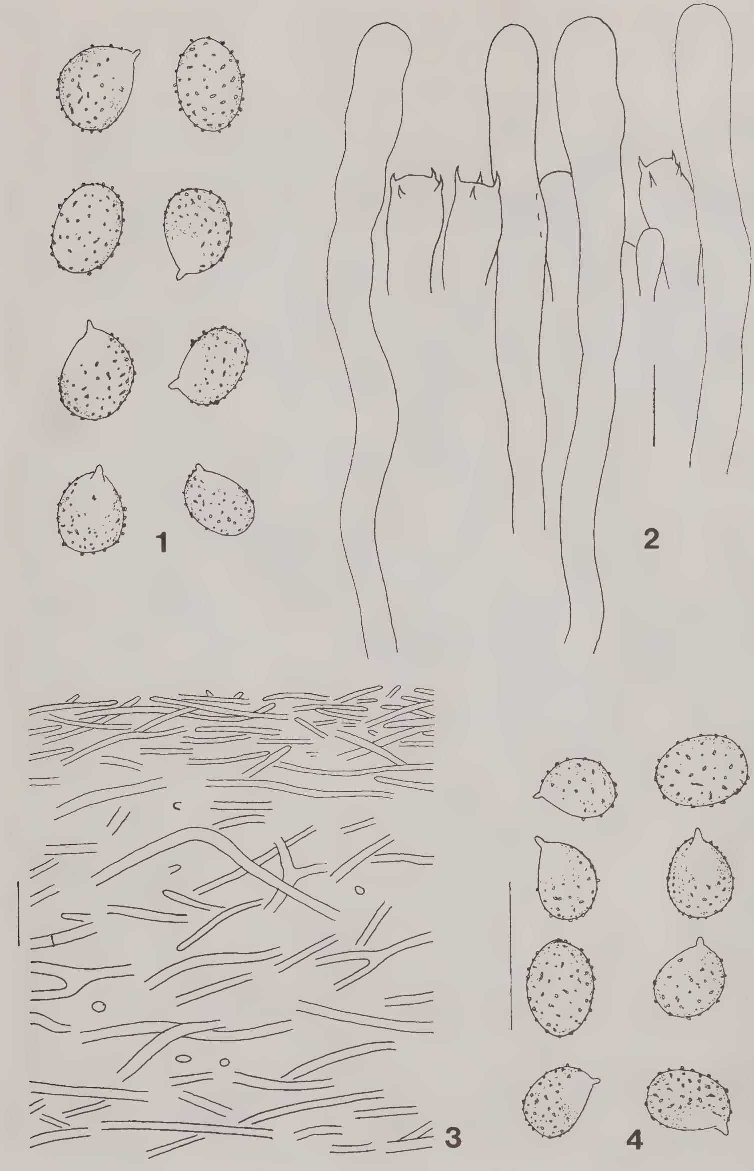
Lactarius furcatus Coker, *J. Elisha Mitchell Sci. Soc. 34*: 18 (1918)

Figs. 1-9

Pileus 30-70 mm wide, plane to centrally depressed, infundibuliform, irregularly undulate, frequently with a sinus dividing the pileus eccentrically in two irregular lobes, yellow to pale honey yellow (5B7-B8), with concentric zones, more conspicuous when wet and then orange brown (6B8-C8), subviscid, finely and irregularly subtomentose (under lens) on disc; margin decurved, pruinose to matted subtomentose, not bearded, viscid. Lamellae adnate to subdecurrent, pale yellowish, pale orangish pink (4A4-3 to 5A4-3) to dark honey yellow (5B7), close to crowded, thick, bifurcate at different levels, narrow (approx. 1 mm wide), with even edges. Stipe 20-40 x 10-15 mm, central or eccentric, simple or caespitose, subviscid, whitish to yellowish or dark yellow (5B7) when wet, with superficial spots (darker than the remaining surfaces) scrobiculi (yellow and subviscid), upper part of the stipe surrounded by a fine whitish tomentum. Context whitish, unchanging or subglaucous. Latex white, staining tissues grayish-green. Odor mild to slightly fragrant. Taste acrid.

Basidiospores (4-) 4.4-6 (-6.4) x 3.2-4.4 (4.8) μm; **RM** = 4.8-5.2 x 3.5-4 μm; **QM** = 1.24-1.42; ellipsoid, finely verrucose, ornamentation low, up to 0.2 μm high, at times with amyloid dot at plage area; Under SEM the verrucae appear fine, rounded or occasionally semiconic, free or at times aligned and joined in catenulate bands. Basidia 44-56 x 4.8-6.4 μm, clavate to subcylindric, tetrasporic. Cystidia absent, pseudocystidia 4.8-12 μm wide, sinuate, when young emerging beyond hymenial layer, buried or inconspicuos when mature. Pileipellis an ixocutis, hyphae 2.4-6.4 μm wide, loosely arranged, irregularly intermixed and with some elements more or less ascendant; the epicutis appears more compact in arrangement; hyphae disposed in mounds, and at times present ascending terminal segments, at this level the elements appear yellowish, pale yellowish-brown to pale orange-brown, being more colored than the other hyphae of the pileipellis, whitout encrusted pigment. Context built of hyphae 4-9.6 μm wide, with sphaerocytes 16-32 μm wide, disposed in conspicuous rosettes, laticifers 3.2-6.4 μm wide. Hymenophoral trama hyphae 1.6-8 μm wide, gelatinized towards the margin; laticifers 1.6-8 μm wide, tending to form a central stratum. Stipitipellis a loosely arranged cutis, slightly gelatinized, hyphae 2-4.8 μm wide, terminal elements somewhat loosely arranged and weakly projected.

Habitat. Mexico: In mesophytic forest, under *Quercus spp*., close to *Q. oleoides*. Costa Rica: among *Quercus spp*. and *Q. corrugata*.



Figs. 1-4. ***Lactarius furcatus*****. Fig. 1**. Basidiospores. **Fig. 2**. Hymenial elements. **Fig. 3**. Pileipellis (Montoya 717). **Fig. 4**. basidiospores (A.H. Smith 10266) (scale bar = 10 µm).

Material studied. **COSTA RICA**. Puntarenas: Coto Brus, Las Mellizas. La Amistad Lodge, near Parque Internacional La Amistad, 3.VII.1998, *Halling 7804* (*USJ 65748*; NY). **MEXICO**. Veracruz: Mpio. Huatusco, near Axocuapan, road Totutla-Xalapa, 2.VIII.1990, *Chacón 4365*; 2.VIII.1990, *Montoya 717* (both in XAL). **U.S.**: Tennessee, Blount Co., Cades Coves Park entrance, Great Smoky Mts. National Park, 16.VIII.1938, *A.H. Smith 10266* (MICH).

The species is apparently rare. Since the description by Coker (1918), based on material gathered in the eastern U.S. (North Carolina), an account of the type specimen was provided by Hesler and Smith (1979). Fieldwork conducted in Mexico revealed that *Lactarius furcatus* is infrequent in the Gulf of Mexico area, where it appears sporadically, and we have just detected a population in a mesophytic forest in Veracruz. Continuous explorations in the area during the last two years have fail to find new samples. Regarding to its distribution in Costa Rica, it has been found only once in southern Costa Rica near the Panamanian border.

The morphological data provided in the descriptions by Coker (1918) and Hesler and Smith (1979) embraces the variation exhibited by our recent collections. Distinctive features for *Lactarius furcatus* are the well defined concentric zones of the pileus, the short, somewhat thick and bifurcate lamellae, the basidiospore size, which is short among the *Lactarius* species, and their finely verrucose pattern of ornamentation. Basidiomes depicted by Coker (Pl. 14) show part of the variation regarding the pileus and lamellae. The collection, Coker 2232 (holotype) from North Carolina, is apparently lost. It is not kept at NCU as indicated by Hesler and Smith (1979), and we have not found it at MICH or NY. The material Smith 10266 identified by Smith as *Lactarius furcatus* agrees well with the description by Coker (1918) and Hesler and Smith (1979). In this collection, the distinctive features mentioned above are clearly defined and are also in correspondence with Mexican and Costa Rican specimens. Among the samples studied a consistent lateral sinus on the pileus, which is variable in size and produces two rounded and faintly convolute lobules, gives the pileus a somewhat reniform aspect. Our fresh collections allowed us to detect a grayish-green staining of the latex, although additional collections will let us check the consistency of its intensity with time; Coker (1918) described it becoming "glaucous green after many minutes".

The specimens studied showed the similar zonate pileus pattern, similar basidiome colors, white latex staining grayish green, and matted subtomentose pileus margin, as in members of *L. zonarius* group. Under current taxonomic criteria, *Lactarius furcatus* should be treated in subsect. *Zonarii* (Quél.) Basso of subgenus *Piperites* Fr. Kauffman (Basso, 1999).

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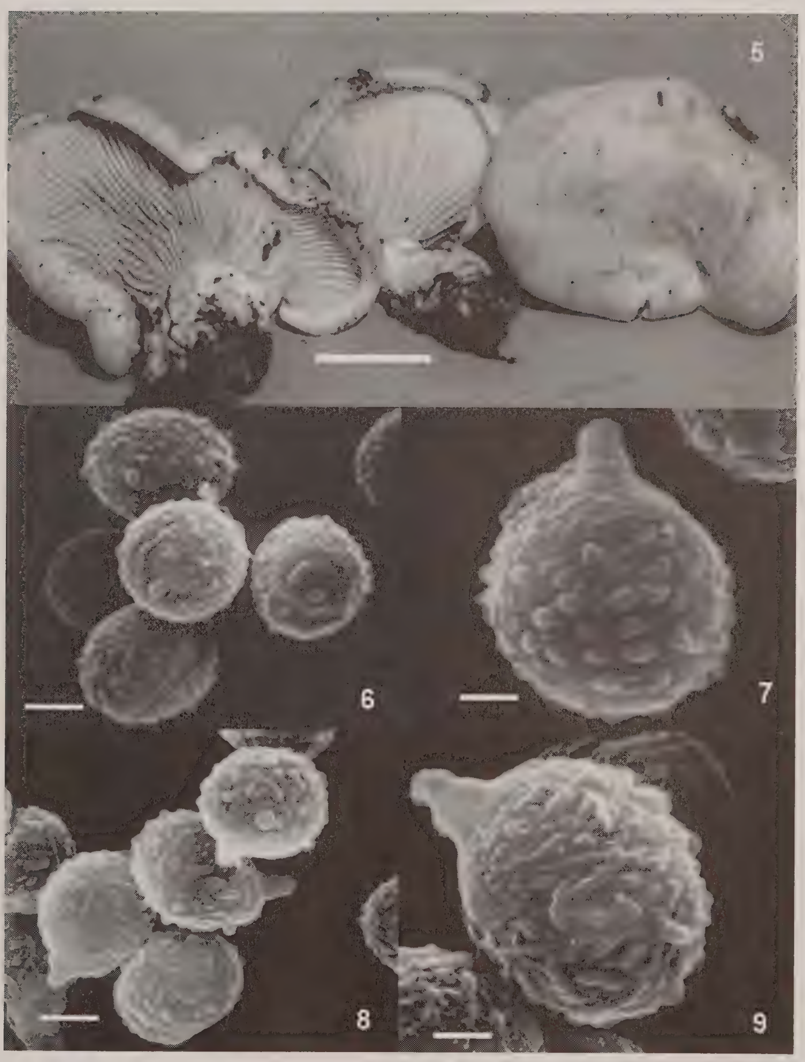

Figs. 5-9. ***Lactarius furcatus***. **Fig. 5**. basidiomes (Halling 7804) (scale bar = 20 mm). **Figs. 6-9**. basidiospores under SEM (Montoya 717) (6, 8 scale bar = 2 μm; 7, 9 = 1 μm).

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MYROTHECIUM ACADIENSE, A NEW HYPHOMYCETE ISOLATED FROM THE WEED TUSSILAGO FARFARA

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Abstract

Myrothecium acadiense, isolated from leaves of the weed *Tussilago farfara* collected in Nova Scotia, Canada, is described as a new anamorph species. It produces sporodochial conidiomata, percurrently proliferating conidiogenous cells, a green, slimy conidial mass and unusual cylindrical conidia that are swollen and convex at the base. Despite the fact that most species of *Myrothecium* have phialidic conidiogenous cells, a phylogenetic analysis of aligned DNA sequences of the 5' end of the large subunit (LSU) rDNA suggest that *M. acadiense* is closely related to the type of the genus, *M. inundatum,* tentatively placed in the *Bionectriaceae, Hypocreales.* Some comments are included on the relationships and generic concept of *Trichothecium roseum.*

Key words: taxonomy, phylogeny, large subunit ribosomal DNA, *Bionectriaceae, Trichothecium*

Introduction

In 1989, an unusual sporodochial fungus was isolated from leaves of the weed *Tussilago farfara* L. (Colts foot) collected in Nova Scotia. Colonies on oatmeal agar grown under near UV light produced sporodochial conidiomata with slimy, dark green conidial masses. The sporodochia were typical of species of the hyphomycete genus *Myrothecium* Tode. However, the conidiogenous cells were not phialidic, as they are in most other species of that genus (Tulloch 1972), but apparently proliferated percurrently. The taxonomy and phylogenetic affinities of this fungus are discussed in this paper, based on studies of morphology using light and scanning electron microscopy, and phylogenetic analysis of partial sequences of large subunit (LSU) ribosomal DNA.

Materials and Methods

Morphological examination — For morphological studies, cultures were grown on oatmeal agar (OA, Gams *et al.* 1998), banana leaf agar (BLA, Matsushima 1971) and Synthetischer nährstoffarmer Agar (SNA, Gerlach & Nirenberg 1982) in the dark at 25°C, or in a 12 hr:12 hr light:dark cycle on a room temperature incubation bench fitted with fluorescent and near UV lights (Burgess *et al.* 1994). Colour codes and capitalized colour names refer to Kornerup & Wanscher (1978). Conidial means and standard errors are based on 36 measurements.

For scanning electron microscopy, specimens were fixed with 4% glutaraldehyde and 0.5% osmium tetroxide, dehydrated in an ethanol series, critical point dried, sputter coated then examined using a Philips XL 30 Environmental SEM.

DNA extraction, DNA sequencing and phylogenetic analyses — For the sequencing of the new species, as well as *Trichothecium campaniforme* Mats. DAOM 222360, the DNA extraction, purification, amplification and sequencing methods used were identical to those described by Seifert *et al.* (1997). Sequences of *Chaunopycnis alba* W. Gams, *Claviceps purpurea* (Fr.) Tul., *Sphaerostilbella aureonitens* (Tul.) Seifert, Samuels & W. Gams, *Spicellum roseum* Nicot & Roquebert and *Trichothecium roseum* (Pers.) Link were obtained from GenBank. Additional strains of *Myrothecium* species, and of other species in the *Hypocreales*, were sequenced as part of a collaborative project with PE Applied Biosystems using proprietary primers. GenBank accession numbers for all sequences are included on Fig. 3. The alignment was calculated using the pileup option of GCG 10.1 (Canadian Bioinformatics Resource http://www.cbr.nrc.ca/) with a gap weight of 5 and a gap length penalty of 1. Minor adjustments were made by eye. The final analysis included 153 phylogenetically informative characters from a total alignment of 1050 bases. Parsimony analysis of alignments were performed with PAUP *4.0b8 (Swofford 1999) using heuristic searches with uninformative characters removed, and further evaluated using bootstrap analysis with 1000 replications using 'fast' stepwise addition.

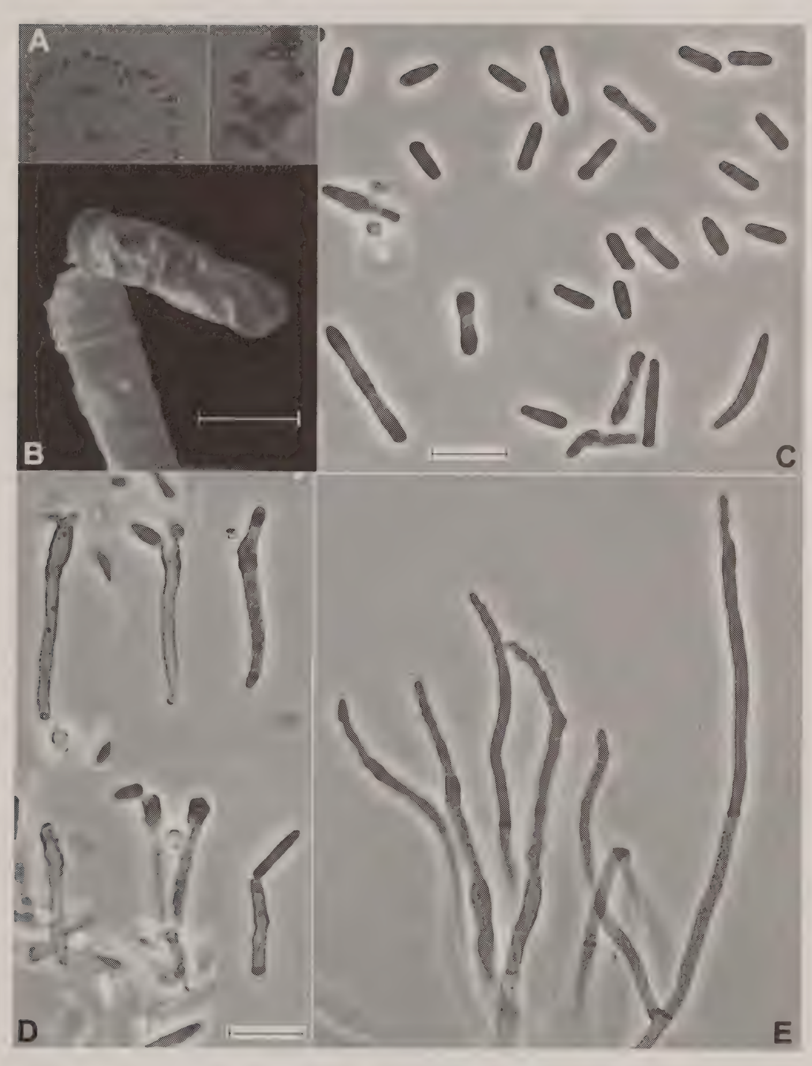


Fig. 1. *Myrothecium acadiense*, ex-type culture, photomicrographs of colony on SNA. A. Sporodochia at two magnifications. B. Conidia. C. SEM of conidiogenous cell, showing percurrent proliferations and detached conidia. D. Detached conidiogenous cells showing zones of percurrent proliferations. E. Marginal hyphae of sporodochium. Note bubble-like warts near the ends of some hyphae.

Taxonomy

Myrothecium acadiense Seifert & G. Sampson, sp. nov.

Figs. 1–2

Coloniae 25°C post 7 dies ca 25–26 mm diam. Sporodochia 100–500 μm diam., postea convergentia. Cellulae conidiogenae percurrenter proliferentes, 16–27 μm longae, 1.5–2.5 μm latae. Massa conidiorum mucosa, initio alba, postea viridis vel fusce viridis. Conidia non-septata vel raro uni-septata, 5.5–16.5 x 1.5–2.5 μm, cylindrica.

Holotypus: DAOM 221473, cultura sicca, isolata ex Tussilagine farfara, G. Sampson, 2 Oct. 1989, Shubenacadie, Nova Scotia.

Sporodochia mostly 100–500 μm diam and about 100 μm deep (excluding conidial mass), at first circular in outline but becoming irregular in outline as adjacent sporodochia coalesce, beginning as a superficial, white cushion of mycelium that becomes light pink, then changes to dark green as slimy conidia develop, with a shiny white margin generally visible around the conidial mass, setae not observed; marginal hyphae relatively undifferentiated and sometimes difficult to distinguish from conidiogenous cells, arising from a whorl of 3–5 hyphae near the base of the sporodochium, then branching 2–3 times monopodially, 1.5–2.5 μm wide, 50–125 μm long, somewhat sinuous, especially in the terminal parts, with inconspicuous bubble-like warts up to 1.5 μm across in the terminal 20 μm giving the cells a shiny appearance under the dissecting microscope. Conidiophore branching irregularly penicillate, generally biverticillate, sometimes terverticillate, often with lower branches in pairs rather than whorls, conidiogenous cells in whorls of (2–)3–5 or single and terminal on a branch of the conidiophore; metulae, when present, 9–14 x 2–2.5 μm. Conidiogenous cells 16–27 μm long, cylindrical at the base, 1.5–2.5 μm wide, proliferating percurrently, conidiogenous region 4–15.5 μm long, 2–2.5 μm wide, at first cylindrical with a rounded apex, then after conidium formation is initiated, uneven in outline or somewhat geniculate, sometimes with a dense region of annellations up to 8 μm long, lacking obvious scars or denticles. Conidial mass at first clear, then turning light green then Dark Green (28-29F8) as conidia mature, dispersing readily in water. Conidia aseptate or occasionally 1-septate, 5.5–16.5 x 1.5–2.5 μm, ($\bar{x}$ = 7.5±0.5 x 2.0±0.05) cylindrical, straight or bent, sometimes unequal in outline, base sometimes wider than the rest of the cell,

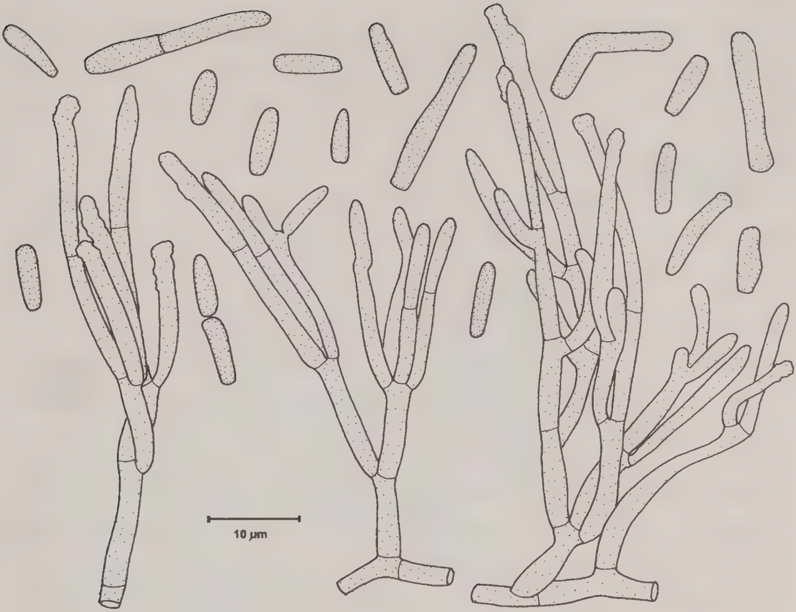


Fig. 2. *Myrothecium acadiense*, ex-type culture, line drawings made using drawing tube, from material grown on banana leaf agar. Conidia and conidiophores.

flattened or convex.

Colonies on OA under UV/fluorescent light: 25–26 mm diam after 7 days, 60 mm diam after 14 days, planar, surface smooth, Orange White (5A2), with concentric rings of coalescing, Olive Brown spots (4EF4–5), the outer ring of spots sometimes lighter in colour because of immature sporulation, somewhat mealy between the rings, margin entire, reverse inconspicuous. Colonies on BLA under UV/fluorescent light: 28 mm diam after 7 days, 60–64 mm diam after 14 days, planar, surface more or less mealy, sporulation sparser than on OA, sporodochia produced mostly on the banana leaf and on the inoculum, margin entire. Colonies on OA days at 25°C in the dark: 28–30 mm diam after 7 days, 68 mm diam after 14 days, identical to colonies under UV/fluorescent except lacking the orange colouration in the agar. Colonies on BLA at 25°C in the dark: 29 mm diam after 7 days, 60–62 mm diam after 14 days, similar to those under UV/fluorescent except sporulation only near the inoculum and not on the banana leaf.

Substrate: Isolated from lesions on leaves of Colts foot (*Tussilago* *farfara*).

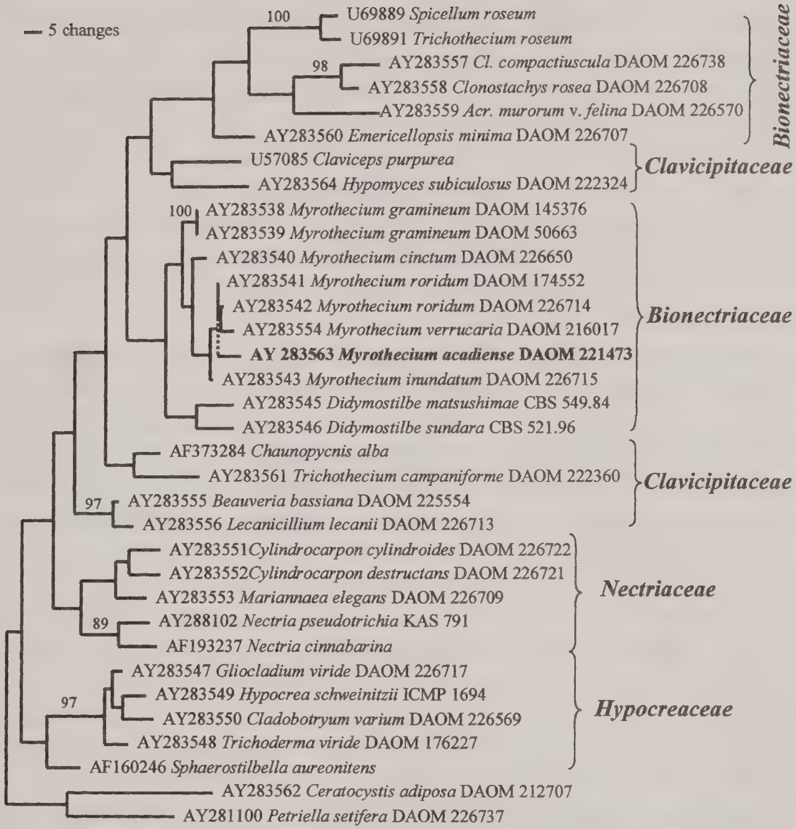
Culture examined: Canada, Nova Scotia, Shubenacadie, isol. by G. Sampson no. 133, 2 Oct. 1989, Nova Scotia (DAOM 221473 = CBS 123.96 = UAMH 7653. Holotype, dried culture herb. DAOM 221473).

Discussion

Myrothecium acadiense can be recognized by the combination of sporodochial conidiomata, percurrently proliferating conidiogenous cells, green, slimy conidial masses and cylindrical conidia that vary considerably in length. We did not observe setae in the sporodochia of our culture, but have noted that at least some setose species of *Myrothecium*, including *M. inundatum* Tode and *M. gramineum* Libert, often do not produce setae *in vitro* even though they are prominent *in vivo*. The unusual shape of the conidia of *M. acadiense*, which sometimes flare at the base to appear narrowly bell-shaped, results from the body of the conidia sometimes being narrower than the attachment point to the conidiogenous cell. After the conidium secedes schizolytically, the basal wall (which is presumably thinner) becomes convex, perhaps bulging as a response to turgor pressure. The species can be distinguished from its closest relatives, *M. roridum* Tode, *M. verrucaria* (Alb. & Schw.) Ditmar and *M. inundatum*, on the basis of its conidial characters and percurrently proliferating conidiogenous cells. As described by Tulloch (1972), the conidia of *M. lachastrae* Sacc. are similar in shape and size (though up to 25 μm long) to those of *M. acadiense*. Our own examination of the holotype (no. 1581, herb. Sacc., PAD) confirms that the conidiogenous cells of *M. lachastrae* are phialides, and that the conidia lack the basal swelling characteristic of *M. acadiense*.

The conidiogenous cells of *M. acadiense* are unusual and the details of conidium ontogeny are difficult to determine using light microscopy. Young conidiogenous cells are cylindrical with a rounded apex. As conidia develop, the outline of the conidiogenous zone becomes uneven or somewhat knobby. SEM reveals the development of nodes of dense annellations. Sometimes, delayed secession of conidia gives a false impression of sympodial proliferation, similar to that seen in *Leptographium* spp. (Wingfield 1985, 1993).

The species of *Myrothecium* sequenced here form a monophyletic group including *M. acadiense*, and comprise a sister genus to *Didymostilbe* P. Henn. As is typical for the LSU analyses published for the *Hypocreales*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U69889 Spicellum roseum
U69891 Trichothecium roseum
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100
AY283538 Myrothecium gramineum DAOM 145376
AY283539 Myrothecium gramineum DAOM 50663
AY283540 Myrothecium cinctum DAOM 226650
AY283541 Myrothecium roridum DAOM 174552
AY283542 Myrothecium roridum DAOM 226714
AY283554 Myrothecium verrucaria DAOM 216017
AY 283563 Myrothecium acadiense DAOM 221473
AY283543 Myrothecium inundatum DAOM 226715
AY283545 Didymostilbe matsushimae CBS 549.84
AY283546 Didymostilbe sundara CBS 521.96
Bionectriaceae
AF373284 Chaunopycnis alba
AY283561 Trichothecium campaniforme DAOM 222360
97
AY283555 Beauveria bassiana DAOM 225554
AY283556 Lecanicillium lecanii DAOM 226713
Clavicipitaceae
AY283551Cylindrocarpon cylindroides DAOM 226722
AY283552Cylindrocarpon destructans DAOM 226721
AY283553 Mariannaea elegans DAOM 226709
89
AY288102 Nectria pseudotrichia KAS 791
AF193237 Nectria cinnabarina
Nectriaceae
AY283547 Gliocladium viride DAOM 226717
97
AY283549 Hypocrea schweinitzii ICMP 1694
AY283550 Cladobotryum varium DAOM 226569
AY283548 Trichoderma viride DAOM 176227
AF160246 Sphaerostilbella aureonitens
Hypocreaceae
AY283562 Ceratocystis adiposa DAOM 212707
AY281100 Petriella setifera DAOM 226737

Fig. 3. Phylogram from an heuristic analysis of aligned LSU sequences of selected species of the *Hypocreales*. One of four equally parsimonious trees of 598 steps (CI = 0.383, RI = 0.593, RC = 0.227, HI = 0.617). The structure of the phylogram is supported by a 100% consensus, with the exception of the dotted branch in the *Myrothecium* clade. Values above some branches represent bootstrap values above 70%. The *Bionectriaceae* and *Clavicipitaceae* are polyphyletic in this analysis.

(Rehner & Samuels 1994, 1995), the topology had poor bootstrap support, but strong strict consensus support, presumably a reflection of the high degree of homoplasy in the data set. As noted by Rossman *et al.* (1999), it is unclear whether the *Bionectriaceae* is a monophyletic group, and in this analysis it appears paraphyletic with taxa attributed to the *Clavicipitaceae*, itself probably a polyphyletic family (Gams *et al.* 1998).

Several species of *Nectria sensu lato* formerly reported as having *Myrothecium* anamorphs are now included in *Bionectria* and these anamorphs are now formally renamed in *Clonostachys* Corda (Schroers 2001). Thus, the only teleomorphs known in the *Myrothecium* clade are species of the enigmatic *Peethambara* Subram. & D.J. Bhat (Rossman *et al.* 1999) with *Didymostilbe* anamorphs. No teleomorphs are known among the species of *Myrothecium* analyzed here. '*Nectria*' *bactridioides* Berk. & Broome was reported to have a *Myrothecium* anamorph by Tulloch (1972) , but this is apparently unconfirmed by culturing, and neither the teleomorph nor the anamorph of this fungus has been reconsidered since that report.

The generic concept of *Myrothecium* has been controversial since Tulloch (1972) monographed the genus. She included species with synnematous and/or sporodochial conidiomata, with marginal hyphae and with or without setae in the conidiomata, phialidic conidiogenous cells, and aseptate conidia produced in a slimy, dark green mass. The concept was criticized for the inclusion of variable conidiomatal types (Nag Raj 1993, 1995), the exclusion of species lacking differentiated marginal hyphae (Samuels & Rossman 1979), and restriction to species with phialidic conidiogenous cells (see below) and dark green conidial masses (Schroers *et al.* 1999). These criticisms can now be reconsidered in light of the LSU phylogeny presented here. Of the species removed to *Xepicula* and *Xepiculopsis* by Nag Raj (1993, 1995) on the basis of conidiomatal anatomy, only *M. gramineum* has been sequenced, and the results presented here suggest this species is appropriately placed in *Myrothecium. Xepiculopsis* Nag Raj (1993), which includes the two morphologically similar species *X. gramineum* (Libert) Nag Raj and the type *X. pelpuchra* Nag Raj, could thus be considered a synonym of *Myrothecium*. Our LSU analysis supports the inclusion of at least some synnematous species, such as *M. cinctum* (Corda) Sacc., which is often synnematous *in vivo*, with the sporodochial species. The phylogenetic distinction between *Myrothecium* and closely related synnematous genera such as *Didymostilbe* and *Albosynnema* E.F. Morris remains to be more fully explored. All of the species of *Myrothecium* sequenced so far have dark green conidial masses, and species with similar conidiomata but lighter brown conidia appear to be phylogenetically distinct. Schroers (2001) used the term 'myrothecium-like' to describe sporodochia of other anamorphs of the *Bionectriaceae* with light green or brown conidia.

As noted above, *Myrothecium* has generally been considered a genus for species with phialidic conidiogenous cells. Phylogenetic analysis of the LSU rDNA shows that *M. acadiense*, with its percurrently proliferating conidiogenous cells, is closely related to *M. inundatum* and other species of *Myrothecium*. Both *M. flavovirens* B.C. Sutton (1986) and *M. groenlandicum* M. Bohn (1993) were described with percurrently proliferating conidiogenous cells. There are currently no other anamorph genera with sporodochial conidiomata, percurrently proliferating conidiogenous cells, and slimy conidia that would be appropriate for these three species. The concept of *Myrothecium* advocated here, allowing some plasticity of conidiogenesis within a monophyletic genus, is in accord with modern concepts for *Cladobotryum* Nees (anamorphic *Hypocreaceae*, see Rogerson & Samuels 1993), and other anamorph genera.

Some comments on other anamorph genera are germane following the analysis of LSU sequences reported here, in the context of the recent reevaluation of the families and genera of the *Hypocreales* provided by Rossman *et al.* (1999). Seifert *et al.* (1997) demonstrated the close relationship of *Spicellum roseum* and *Trichothecium roseum* in the *Hypocreales*, but did not comment on family relationships. In the present analysis, both species (the types of their respective genera) appear to belong to the *Bionectriaceae*. *Trichothecium* has generally been considered an anamorph of the *Hypocreaceae*, on the basis of the connection of the reported trichothecium-like anamorph of *Hypomyces trichothecioides* Tubaki (= *H. subiculosus* (Berk. & M.A. Curtis) Höhnel). Our reexamination of this anamorph confirmed that it produces imbricate conidial chains, but revealed phialidic conidiogenous cells and verticillate conidiophore branching. *Trichothecium roseum* is a commonly mentioned example of blastic retrogressive conidiogenesis, a pattern also seen in some *Hypomyces* anamorphs. A third species attributed to *Trichothecium*, *T. campaniforme*, seems to be related to the *Clavicipitaceae* in this analysis. Clearly, the present concept of *Trichothecium* is polyphyletic, and the genus should be restricted to its type species or else redefined in a manner that emphasizes its relatively close relationship with *Spicellum roseum*.

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LICHENS OF THE McLEAN BOGS BASIN NEAR ITHACA, NEW YORK

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Abstract: Cornell University's 40-ha McLean Bogs Preserve in Tompkins County, New York, USA, was given to the University by Curtis G. Lloyd ca. 80 years ago. McLean's mycological richness is well known, based on a thorough biological survey published in 1926. Its calcareous lowlands are juxtaposed with acidic quaking bogs and steep upland forest, providing a wide variety of wetland habitats. Since lichens were not included in the 1926 report, we surveyed them at the Preserve in 2002. After finding 36 historical lichen vouchers in CUP and OS (collected 1944-1989), we searched each habitat type, prepared specimens of all macrolichens and some crustose species encountered, and compiled a specimen database that is available online at CUP. We recorded 66 primarily corticolous and lignicolous species, 51 new in 2002. This is the first extensive lichen list for any locality in the Finger Lakes Region of central New York, and includes brief notes on microhabitats, substrates, and identifying characteristics.

Additional key words: Curtis G. Lloyd, wetlands, biotic inventory, floristics

INTRODUCTION

CORNELL UNIVERSITY'S MCLEAN BOGS PRESERVE lies in the northeastern corner of Tompkins County, New York, USA (Fig. 1). Nestled in a glacial kame-and-kettle landscape, McLean's biotic richness derives as much from its edaphic conditions as from foresighted preservation. In this Preserve, calcareous fen-meadows, springs, waterways, pools, and extensive shrub-swamps are juxtaposed with acidic quaking bogs and steep upland woods. These extremes of topography and soil pH provide a large variety of habitats with an associated wealth of plants, animals, and fungi.

Scientific exploration of the "Round Marshes," an earlier name for McLean Bogs, began in the 1870s (Dudley 1886, Needham 1921). About 50 years later, Curtis G. Lloyd, a wealthy mycologist from Cincinnati, Ohio (Mayo 1928), purchased the 84-acre (33.5-ha) boggy tract and donated it to Cornell University as a "forever wild" Lloyd-Cornell Reservation through the Lloyd Library and Museum (Needham 1921; Lloyd Library website, http://www.lloydlibrary.org). McLean was recognized as a National Natural Landmark in 1973 (Ostman & Wesley 1997). Addition of the adjoining Fitzpatrick Fen in 1988 increased the Preserve's holdings to 100 acres (40 ha) (Ostman & Wesley 1997).

A biotic inventory of McLean that commenced in the spring of 1916 resulted in a highly detailed *Preliminary Biological Survey of the Lloyd-Cornell Reservation* (Scientific Staff of Cornell University 1926). This remains one of the earliest and most thorough documents of its kind for any natural area in northeastern North America, and can still be purchased for US$30.00 from the Lloyd Library and Museum, 917 Plum Street, Cincinnati, OH 45202, USA. This famous wetland system is shown on the *Groton, N.Y.*, 7.5' USGS quadrangle [UTM 18 396036E 4710968N] and was discussed by Johnson & Worley (1985) in their book on *Bogs of the Northeast*.

Although many aspects of its biota — including the fungi (Fitzpatrick 1926, Muenscher & Wann 1926) — were inventoried before 1926, McLean's lichens were not studied at that time. A search of CUP's lichen collection revealed only 12 historical vouchers from the Preserve basin, collected by Babette I. Brown and W. C. Muenscher ca. 60 years ago as part of Brown's distributional study of New York epiphytes (Brown 1946, 1948). The Mycological Society of America held its 1952 Foray in the Ithaca area, visiting five localities in Tompkins County, New York, including McLean (Mix 1954). The well known lichenologist Emanuel D. Rudolph attended, later listing 27 lichens collected during the Foray without giving specific locality information (Mix 1954:123); an inquiry to OS (which houses Rudolph's lichen herbarium) produced five additional McLean lichen vouchers from this 1952 visit. Dirig has done serendipitous lichen collecting at the Preserve from 1977-1989, resulting in 19 more specimens, and prepared a field list of ca. 50 McLean lichens (mostly *sans* vouchers) for use in teaching (Dirig 1989). However, there is a real dearth of specimens and published information on lichens for the entire Finger Lakes Region [see Mix (1954) and LaGreca (2001) for context]. Since McLean's lichens have remained largely unstudied, this aspect of the Preserve's biota begged investigation.

Cornell's current Natural Areas Committee (which oversees the Preserve) has sponsored re-surveys of several groups of organisms at McLean during the last five years: the **butterflies** in 1997-1998*ff.* (Keats 1998, Keats & Dirig 1998, Dirig & Keats 1998, Dirig 2002b), **carabid beetles** in 1998-1999*ff.* (Song 2000, Liebherr & Song 2002), **Trichoptera** in 1999-2000 (Wayne Gall, unpublished); and **Odonata** and **scarab beetles** in 2001 [Dirig 2002a; Keith Sendziak and Kyle Beucke, unpublished]. We inventoried the **lichens** in 2002 as part of this continuing effort, and report our results in this paper.

METHODS

AFTER ESTABLISHING A RATHER MEAGRE HISTORICAL BASELINE of McLean lichen specimens and literature, we proceeded with outdoor explorations and collecting. We searched the wide variety of McLean's habitats (see next section and Table 1), keeping voucher specimens of all the macrolichens and a few familiar microlichens we encountered growing on soil, over mosses, and on trees, wooden fence posts, lignum, and rocks. We did not continue to collect common or distinctive species after they had been vouchered to avoid accumulating huge caches of specimens. Most collecting was done in winter and early spring, when green foliage and snow did not obscure substrates. We checked recently fallen trees for limb- and canopy-dwelling lichens, but did not climb to inspect tree boles above 8 ft. (2.4 m), so there is a vertical, ground-level bias in our sampling. We also tried to avoid collecting sterile mats of *Cladonia* squamules (since they are often so difficult to identify), and thus may have failed to document the full spectrum of habitats occupied by some species of this genus.

Each specimen was housed in a 4 × 6 inch (10.1 × 15.2 cm) packet made of folded archival paper with a computer-generated label glued on the outside. Labels identify the specimens as part of this study, and each packet contains a small sketch map of the Preserve with the site of collection indicated in red. We deposited the 159 specimens collected to document this survey in CUP, with a few duplicates at FH, as indicated in our Species List. Details from our specimen labels are available online at CUP [http://ppathw3.cals.cornell.edu:8100/CUPPDatabase/index.html].

We identified specimens based on morphological characters and chemical spot tests (K, C, KC, and PD), using keys and descriptions in Hale (1979), Brodo *et al.* (2001), and other standard lichen references and monographs. Scott LaGreca of the Farlow Herbarium at Harvard University assisted with a few difficult determinations that required thin-layer chromatography. A small residue of unidentified (or presently unidentifiable) *Cladonia*, *Usnea*, and crusts has been stored at CUP for future study.

STUDY SITE CHARACTERISTICS

MCLEAN'S DIVERSE HABITATS are shown on the accompanying map (Fig. 1). Specific named sites (in **bold** type) that appear on our specimen labels are described below.

The **Right-of-Way** (abbreviated "**ROW**" hereafter) is a mowed grassy lane running north from Sweetland Road. It is first bordered by deciduous saplings and a

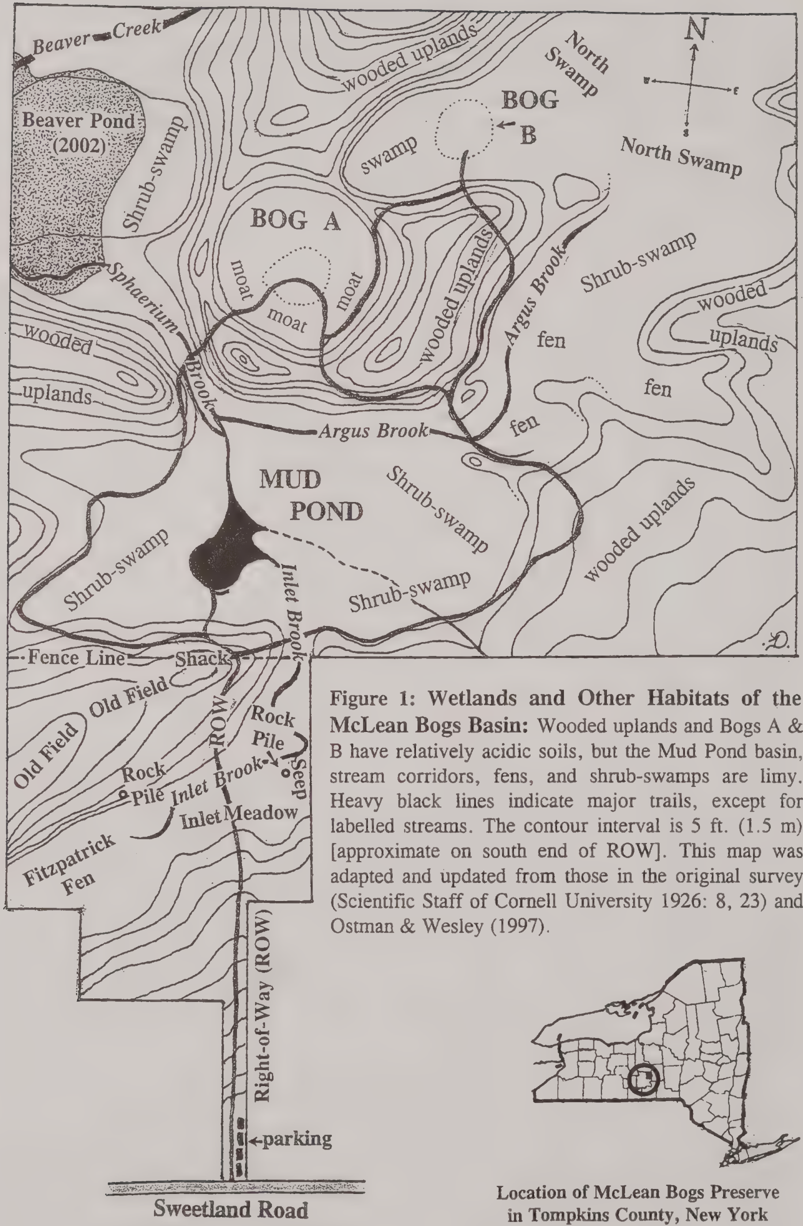
Beaver Creek
Beaver Pond (2002)
Shrub-swamp
wooded uplands
North Swamp
N
BOG B
swamp
North Swamp
BOG A
moat
moat
moat
Sphaerium Brook
wooded uplands
Argus Brook
Shrub-swamp
wooded uplands
wooded
uplands
fen
fen
fen
Argus Brook
MUD POND
Shrub-swamp
wooded uplands
Shrub-swamp
Inlet Brook
Shrub-swamp
Fence Line
Shack
Old Field
Old Field
ROW
Rock Pile
Seep
Rock Pile
Inlet Brook
Inlet Meadow
Fitzpatrick Fen
Right-of-Way (ROW)
parking
Sweetland Road

Figure 1: Wetlands and Other Habitats of the McLean Bogs Basin: Wooded uplands and Bogs A & B have relatively acidic soils, but the Mud Pond basin, stream corridors, fens, and shrub-swamps are limy. Heavy black lines indicate major trails, except for labelled streams. The contour interval is 5 ft. (1.5 m) [approximate on south end of ROW]. This map was adapted and updated from those in the original survey (Scientific Staff of Cornell University 1926: 8, 23) and Ostman & Wesley (1997).

Location of McLean Bogs Preserve in Tompkins County, New York

few Norway Spruces (*Picea abies)*, then opens to provide a panoramic view of the Preserve. Continuing downhill, it passes a taller, cultivated spruce hedge on the east and young woodland on the west, then opens into a small mowed **Inlet Meadow** at the bottom. Spruces, shrubs, and wooden fence posts bordering the ROW provide important lichen substrates, but vegetational succession and intermittent mowing of the footpath restrict terricolous species there.

Wooden planks carry the ROW across **Inlet Brook**, a calcareous stream that drains from **Fitzpatrick Fen** (hereafter referred to as the "**Fen**") on the southwest. This shallow fen basin is fed by three alkaline springs from a morainal ridge (kame) on the southeast, is underlain by marl, and is dominated by sedges (*Carex stricta, C. aquatilis, C. lacustris)*, Bluejoint Grass (*Calamagrostis canadensis),* Broad-leaved Cattail (*Typha latifolia)*, Red-osier Dogwood (*Cornus sericea)*, Alder-leaved Buckthorn (*Rhamnus alnifolia)*, Silky Willow (*Salix sericea)*, and other scattered shrubs. It harbors surprisingly few lichens, except on its very limited large trees.

A fallow **Old Field** abuts the Fen on an undulating ridge that is overgrown with goldenrods (*Solidago* spp. and *Euthamia graminifolia)*, other hardy herbs, and Wild Blackberries (*Rubus allegheniensis)*. Occasional mowing keeps this field somewhat open, but thickets of shrubs (especially Grey Dogwood, *Cornus foemina* ssp. *racemosa)* have crowded its edges during the past 10-15 years. A few *Xanthoparmeliae* and terricolous *Cladoniae* persist there in more open areas. A shaded **Rock Pile** (evidently picked from the field many years ago) edges the Fen on the north side, providing substrates for a few saxicolous lichens. Another **Rock Pile** under a White Pine (*Pinus strobus)* near Inlet Brook at the northeastern corner of Inlet Meadow harbors a similar assemblage of rock-inhabiting species. A calcareous **Seep** in this area also has exposed cobbles and a few erratics that support more *Xanthoparmeliae*, *Cladoniae*, and crusts.

Following the ROW to its northern terminus, one penetrates the forest curtain at the original **Fence Line** near the site of the former **Shack**, a rustic lodge used by scientists who stayed at the Preserve for extended periods. Through a screen of mature Hemlocks (*Tsuga canadensis)*, Yellow Birches (*Betula alleghaniensis)*, Black Cherries (*Prunus serotina)*, and Sugar Maples (*Acer saccharum)* one can glimpse the large, calcareous **Mud Pond** basin. This has an open central pool surrounded by a marshy quaking mat of *Typha,* sedges, wetland herbs, and scattered shrubs, amid standing dead trees from brief Beaver flooding in 1980-1981. Extensive **Shrub-swamps** — nearly impenetrable thickets of wetland shrubs, dominated by Speckled Alder (*Alnus incana* ssp. *rugosa)* — fill the western, southern, and eastern edges of this basin, while Inlet Brook and **Argus Brook** enter on the south and northeast, respectively. Footpaths around Mud Pond pass through steep, mostly deciduous woodlands that are carpeted with spectacular displays of spring wildflowers before canopy closure in mid-May. A very few siliceous erratics are exposed in these seasonally shaded forest habitats, providing substrates for *Porpidia albocaerulescens.* Mud Pond drains north into **Sphaerium Book** (named for a small clam that lives in its bed), which quietly flows through thin woods and another extensive **Shrub-swamp** before reaching **Beaver Creek**. The juncture of these two waterways and part of the surrounding Shrub-swamp have been flooded by an extensive **Beaver Pond** since autumn 1999 (Dirig 2000:5) — a cycle that has continued throughout the Preserve's history, and probably long before. Fig. 1 shows the extent of flooding through 2002.

Two *Sphagnum*-heath quaking bogs occupy deep kettle holes in the north-central part of the Preserve (a third bog northeast of the northern Preserve boundary was obliterated by succession in the mid-1900s). These acidic peaty mires formed after glacial recession, and receive their water from runoff and rain. They often retain relict northern organisms in central New York, hundreds of miles south of their present centers of abundance. **Bog A** still has a fragile floating mat with glimpses of open water in the center, and is easily accessed by a boardwalk that prevents trampling (Ostman 1993). The shrubby "moat" around its outer edges is dominated by Highbush Blueberries (*Vaccinium corymbosum)*, Black Chokeberries (*Aronia melanocarpa)*, Red Maples (*Acer rubrum)*, and Hemlocks, and harbors many of the most interesting lichens of the Preserve. The formerly open mat of **Bog B** had become overgrown by shrubs and young trees since the 1970s due to vegetational succession, but was reopened by cutting in 2000 (Dirig 2001:10), and a few of its noteworthy lichens survive.

North Swamp is an extensive forested wetland in the Preserve's northeastern corner. It has many of the same trees and shrubs as Bog A, among them Hemlock, Red Maple, Yellow Birch, and Black Ash (*Fraxinus nigra)*. It shelters boreal herbs and mosses on hummocks and around the bases of fallen trees, and is another prime lichen habitat, supporting many of the Preserve's least common species.

Swamp and bog trees are shallow-rooted in deep muck and peat at McLean, and are regularly toppled by high winds, so they rarely attain large size. Standing trees are often widely spaced in these habitats.

Because of McLean's early preservation, it is still possible to see all of these wetland types in relatively undisturbed condition, with their associated rich biotic arrays, except where altered by Beaver activity or human foot traffic.

SPECIES LIST

GENERA AND SPECIES ARE ARRANGED ALPHABETICALLY. Scientific names of lichens follow Esslinger (1997-2002); lichen vernacular names are from Nearing (1962) and Brodo *et al.* (2001), with a very few proposed by us (marked with an asterisk); while vascular plant nomenclature follows Mitchell & Tucker (1997). Specimen numbers preceded by *HTR*- are Heather Taylor Root collections; those preceded by *L*- are Robert Dirig specimens. All cited vouchers from this study (as well as Brown & Muenscher's and most of Dirig's historical vouchers) have been deposited in CUP, with a few duplicates elsewhere, as noted. Some older Dirig collections were only deposited in NY or NYS, and a very few duplicates remain in his personal herbarium (indicated by "R.D.").

***Acarospora fuscata* (Schrader) Arnold, BROWN CHIP LICHEN.** Saxicolous, Rock Pile near the Fen (*HTR-193)*. This species usually grows on sunlit acidic rocks.

Allocetraria oakesiana **(Tuck.) Randlane & Thell, OAKES' SHIELD LICHEN, YELLOW RIBBON LICHEN.** Collected in Bog A in 1984 (*L-1635* in NY) and observed there with the rarely reported brown, marginal apothecia (Dirig 1989). It is still frequent in the shrub zones of Bogs A & B, on *Acer rubrum* (*HTR-115*), *Vaccinium corymbosum* (*HTR-140*), and *Tsuga canadensis* (*HTR-176*).

Anaptychia palmulata **(Michaux) Vainio, SHAGGY FRINGE LICHEN.** Historically found on *Ulmus* sp. (*Brown & Muenscher 382,* who identified it as *"Physcia endochrysea"*). We found it on a shaded *Fraxinus* sp. trunk near the Beaver Pond (*HTR-231*).

Arthonia caesia **(Flowtow) Körber, FROSTED COMMA LICHEN.** Corticolous at the bases of shrubs and dead trees: on *Cornus foemina* ssp. *racemosa*, ROW (*HTR-188,* dupl. in FH); on *Alnus incana* ssp. *rugosa* (*HTR-206*) and lignum (*HTR-196B*), Mud Pond basin; and on dead *Acer rubrum* (*HTR-133, HTR-145*) and unidentified lignum (*HTR-148*), Bog A. The thin, pale greenish-grey, sorediate thallus with blue pruinose apothecia is distinctive (although it is not always found fertile). This species must be an excellent early colonizer, judging from its ubiquity throughout wetter parts of the Preserve.

Bryoria furcellata **(Fr.) Brodo & D. Hawksw., MOUSTACHE LICHEN.** Collected in 1984 (*L-1638* in NY) and observed on *Tsuga canadensis* by Dirig (1989) in Bog A, but less common in the interim, due to decorticating and falling of dead conifer substrates. Found once during this survey on the trunk of a mature *Pinus strobus* in the Bog A moat (*HTR-153*).

Caloplaca cerina **(Ehrh. *ex* Hedwig) Th. Fr., GREY-RIMMED FIREDOT.** On sunny branches of a dead *Populus* sp. in a gravel pit on the west edge of the Preserve (*HTR-244*).

Caloplaca holocarpa **(Hoffm. *ex* Ach.) M. Wade, FIREDOT LICHEN.** Intergrown with the preceding species (*HTR-227*).

Candelaria concolor **(Dickson) Stein, LEMON or CANDLEFLAME LICHEN.** Corticolous on *Acer negundo,* ROW (*HTR-169, HTR-194*); and on fallen *Acer saccharum* trunk in full sun, Old Field (*HTR-214*). This bright, miniature, foliose species seems to be a good colonizer in disturbed habitats.

Candelariella efflorescens **R. C. Harris & W. R. Buck, POWDERY GOLDSPECK LICHEN.** On trees in the Mud Pond basin (Dirig 1989). Found in 2002 on dead *Populus* sp., Beaver Pond (*HTR-223*); on *Carpinus caroliniana,* Sphaerium Brook (*HTR-122*); on top of an old fence post, ROW (*HTR-152*); on fallen branch, Bog A (*HTR-132*); and on fallen *Acer saccharum* trunk in full sun, Old Field (*HTR-217*).

Cetrelia olivetorum **(Nyl.) W. Culb. & C. Culb., OLIVE SEA-STORM LICHEN.** Historically reported on *Betula alleghaniensis* [*Brown & Muenscher 379,* as "*Parmelia perlata* (L.) Ach."].

Chaenotheca furfuracea (L.) Tibell, SULPHUR STUBBLE LICHEN. On the north (shaded) side of upturned *Tsuga canadensis* roots, over a small pool, Beaver Pond (*HTR-228*). This bright chartreuse species occurs locally in similar microhabitats throughout wetter parts of the Preserve.

Cladonia caespiticia (Pers.) Flörke, STUBBY STALKED CLADONIA. On a dead, fallen tree propped above a small pool by *Tsuga canadensis* roots (*HTR-247*) and on fallen *T. canadensis* log (*HTR-249*), Bog B.

Cladonia coniocraea (Flörke) Sprengel, COMMON POWDER HORN. On a dead, fallen tree propped above a small pool by *Tsuga canadensis* roots (*HTR-254*), Bog B; and on fallen *T. canadensis* log (*HTR-233*), Beaver Pond.

Cladonia cryptochlorophaea Asah., PIXIE CUP. Saxicolous in Rock Pile near the Fen (*HTR-198*); and on pink granite erratic in full sun near the Seep in Inlet Meadow (*HTR-239*). Cryptochlorophaeic acid was demonstrated using TLC.

Cladonia cylindrica (A. Evans) A. Evans. On *Acer rubrum* in Bog A (*HTR-109*) and Bog B (*HTR-203, HTR-209*).

Cladonia furcata (Hudson) Schrader, FORKED SHRUBLET LICHEN, MANY-FORKED CLADONIA. Formerly much more abundant in an earlier stage of vegetational succession in Inlet Meadow (Dirig 1989) — where we still found a few thalli beneath young shrubs in 2002 (*HTR-212*). Also at edge of Fen in the Old Field (*HTR-191*); on edge of ROW path (*HTR-235*); and under small shrubs on slope at edge of Old Field (*L-7536,* dupl. in FH). Terricolous and sometimes intergrown with bryophytes, these were all brownish "sun forms" with relatively sparse podetial squamules. We did not observe the greener, more richly squamulose "shade form" of *C. furcata* anywhere in the Preserve's forested uplands.

Cladonia macilenta Hoffm., LIPSTICK POWDERHORN. Saxicolous in Rock Pile near the Fen (*HTR-200*); lignicolous, Bog A (*HTR-124*); **var. _bacillaris_ (Genth) Schaerer,** on large hummock at periphery of Bog B (*HTR-205*).

Cladonia ochrochlora Flörke, SMOOTH-FOOTED POWDERHORN. On damp lignum, Shrub-swamp south of Mud Pond (*HTR-201*).

Cladonia parasitica (Hoffm.) Hoffm., FENCE-RAIL CLADONIA. On fallen log, wooded uplands south of Mud Pond basin, 1989 (*L-2986*).

Cladonia pyxidata (L.) Hoffm., PEBBLED PIXIE CUP. Shrub zone between Old Field and Fen on partially buried quartzite rock in sun (*HTR-221*). This species was reported from 18 woody substrates in the McLean basin by Brown (1946:54), but lacking any vouchers in CUP, we cannot include these records, due to possible confusion with several other similar species of Pixie Cups.

Cladonia ramulosa (With.) J. R. Laundon. Lignicolous on fallen log, northeastern end of Mud Pond (*L-7541*).

Cladonia scabriuscula **(Delise) Nyl., MEALY FORKED CLADONIA.** Terricolous among shrubs, southeastern edge of Old Field toward Inlet Brook (*L-7535*, dupl. in FH). This robust *Cladonia* somewhat resembles *C. furcata*, but has coarser sprawling podetia with granular soredia at their tips.

[***Cladonia*** **sp.** A few lignicolous specimens from Bog A could not be determined, even by using TLC (*HTR-107, HTR-142, HTR-147, L-1641)*, but have been retained at CUP for possible future study.]

Evernia mesomorpha **Nyl., BOREAL OAKMOSS.** Historically on *Prunus serotina* (*Brown & Muenscher 84)* and *A. rubrum* [Brown 1946:57, as "*E. prunastri* (L.) Ach."]. Also on various woody substrates, 1984 (*L-1637, L-1646* in NY; *L-1643* in NYS), corticolous on *Acer rubrum* (*HTR-106)*, and lignicolus (*HTR-138)*, all Bog A; and on fallen branches, Bog B (*L-7511)*. This species generally grows in full sun.

Flavoparmelia caperata **(L.) Hale, COMMON GREENSHIELD, WRINKLED SHIELD LICHEN.** Historically found by Brown (1946:64) on *Tsuga canadensis, Populus grandidentata, Ostrya virginiana, Carpinus caroliniana, Betula alleghaniensis* (as *B."lutea"*), *Fagus grandifolia, Quercus bicolor, Ulmus americana, Prunus serotina, Sorbus americana, Acer rubrum, A. saccharum*, and *Fraxinus nigra* (she may also have included the next species, which is similar — there are no vouchers). More recently found on *Fraxinus* sp., Sphaerium Brook corridor (Dirig 1989); on *Acer rubrum*, Bog A (*HTR-134)*; on *Carpinus caroliniana*, Beaver Pond (*HTR-224)*; and juvenile thalli on *Picea abies*, ROW (*HTR-250)*. This conspicuous bright yellow-green species is common on trees along forest edges, stream courses, and in woodland openings.

Flavopunctelia flaventior **(Stirton) Hale, SPECKLED GREENSHIELD.** Corticolous on *Acer rubrum*, Bog A (*HTR-110, HTR-146)*; on dead *Acer saccharum* (*HTR-226)*, and on dead branch on ground, Beaver Pond (*HTR-225)*; and on a fallen, sunlit *A. saccharum* trunk, Old Field (*HTR-218)*. The Speckled Greenshield is common throughout the Preserve. It is distinguished from the very similar *Flavoparmelia caperata* by its slightly darker green upper cortex, white pseudocyphellae, and C+ red medulla.

Fuscidia arboricola **Coppins & Tønsberg, QUILT LICHEN.** On dead *Acer rubrum*, Bog A (*HTR-133A)*.

Graphis scripta **(L.) Ach., *ELVENSCRIPT, *ELVEN RUNE LICHEN.** Historically found on *Fraxinus nigra* (*Brown & Muenscher 384;* Brown 1946:58), *Carpinus caroliniana, Betula alleghaniensis, Fagus grandifolia, Acer saccharum*, and *Tilia americana* (Brown 1946:58); and *B. alleghaniensis* (*Rudolph s.n.* in OS). This distinctive crust is widespread in wetter parts of the Preserve. We found it on bark of *Ilex verticillata* (*HTR-161)*, *Viburnum nudum* var. *cassinoides* (*HTR-183)*, and *B. alleghaniensis* (on *both sides* of peeling bark rolls!) (*HTR-195)* in Bog B and North Swamp; on living (*HTR-172*, dupl. in FH) and dead (*HTR-171) C. caroliniana* along Argus Brook; and at the base of *B. alleghaniensis* trunks in wooded uplands east of Mud Pond (*HTR-187)* and on the rim of Bog A (Dirig 1989). Crust color and apothecial shape vary greatly.

Hypocenomyce scalaris **(Ach.) M. Choisy, OYSTER LICHEN.** On *Prunus serotina* trunk in dappled shade, Fence Line near the Shack (Dirig 1989; *L-7538)*; on dead *Tsuga canadensis* (*HTR-121)* and on *Pinus strobus* bark (*HTR-131)* in shrub zone of Bog A. See Dirig (1990) for detailed ecological notes on this subtle squamulose species, which grows on highly acidic substrates of pH 4.0-4.7.

Hypogymnia physodes **(L.) Nyl., PUFFED SHIELD LICHEN.** Found in 1944-1945 on *Tsuga canadensis, Carpinus caroliniana, Alnus incana* ssp. *rugosa, Acer rubrum, A. saccharum, Tilia americana*, and *Fraxinus nigra* at McLean by Brown [1946:70, as "*Parmelia physodes* (L.) Ach."]. Collected 50 years ago on "trees in swamp" (*Rudolph s.n.* in OS). Also corticolous in 1977 (*L-586,* dupls. in FH, R.D.); and lignicolous (*HTR-137, HTR-151)*, on fallen *Acer rubrum* (*HTR-243)*, and on *A. rubrum* sapling in full sun (*HTR-207)* in 2002, all in Bog A; and on bog shrubs (Dirig 1989), on downed *P. strobus* branch (*HTR-162)*, on *Tsuga canadensis* bark (*HTR-103)*, and lignicolous in open sun (*HTR-246)* in Bog B. Very common in Bog A, covering trunks and branches in the shrubby moat. We found a fertile thallus on 7 April 2002 in Bog A, where the rarely seen apothecia (Hale 1979:73) were also reported by Dirig (1989).

Imshaugia aleurites **(Ach.) S. F. Meyer, GRIZZLED SHIELD LICHEN.** Abundant on sunlit branches into the canopy of a dead, recently fallen *Pinus strobus* (*H-135, H-154)*, and on exposed bark of *Vaccinium corymbosum* (*HTR-108, HTR-216, HTR-251)*, Bog A.

Lecanora symmicta **(Ach.) Ach., FUSED RIM LICHEN.** On *Picea abies* twigs (*HTR-166, HTR-168, H-186)* and fallen *Salix* sp. branch (*HTR-180)*, ROW.

Lecanora thysanophora **R. C. Harris, MAPLEDUST LICHEN.** On tree trunks, Mud Pond basin and surrounding trails (Dirig 1989; *HTR-196a)*; on *Acer saccharum* bark, Bog A (*HTR-105)*; and on *Fraxinus* sp. bark, Beaver Pond (*HTR-234)*. The white, webby prothallus and massed, bright green soredia distinguish this lovely crust.

Lecidea tessellata **Flörke, TILE LICHEN.** Saxicolous in Rock Pile under *Pinus strobus* at base of Inlet Meadow (*HTR-238, HTR-241)*. Containing confluentic acid, "an odd form — young?" (S. LaGreca annotation, 2002). We also observed this lichen growing on rocks edging the adjacent Seep.

Lepraria lobificans **Nyl., FLUFFY DUST LICHEN.** On dying *Acer rubrum,* Bog A (*HTR-123);* on lignum, Bog B (*HTR-101)*. This species somewhat resembles *Lecanora thysanophora* in color, but lacks its conspicuous white prothallus and exhibits different chemistry (Brodo *et al.* 2001).

Lithothelium hyalosporum **(Nyl.) Aptroot, HOARY STIPPLE LICHEN.** Historically on *Acer saccharum,* 1945 (*Brown & Muenscher 400)*. [Det. by R. C. Harris in 1981 as *Plagiocarpa hyalospora* (Nyl.) R. C. Harris.]

Lobaria pulmonaria **(L.) Hoffm., LUNGWORT.** Collected in 1944 on *Ulmus americana* bark [*Brown & Muenscher 56;* Brown 1946:81, as "*Sticta pulmonaria* (L.) Bir."] and on *Fraxinus nigra* (Brown 1946:81), the only records for this species.

Melanelia fuliginosa **(Fr. *ex* Duby) Essl., SHINY CAMOUFLAGE LICHEN.** Reported on *Prunus virginiana* [*Brown & Muenscher 117,* as "*Parmelia olivacea* (L.) Ach."] in 1944.

Melanelia subaurifera **(Nyl.) Essl., ABRADED CAMOUFLAGE LICHEN.** On *Vaccinium corymbosum* (*HTR-125)* and *Acer rubrum* (*HTR-119)* twigs, Bog A; on *Carpinus caroliniana* bark, Sphaerium Brook (*HTR-129);* on fallen branch, North Swamp (*HTR-256,* dupl. in FH).

Myelochroa aurulenta **(Tuck.) Elix & Hale, *POWDERY CREAM-HEART.** On old *Carpinus caroliniana,* Shrub-swamp south of Mud Pond (*HTR-210)*; and on *Fraxinus* sp., Beaver Pond (*HTR-222).* The bluish-grey cortex and pale yellow medulla are characteristic.

Myelochroa galbina **(Ach.) Elix & Hale, *SMOOTH CREAM-HEART.** Found on *Acer rubrum* bark in 1952 (*Rudolph s.n.* in OS), mixed with *Pyxine sorediata* (see below). *M. galbina* lacks soredia, has a lobulate central thallus with dark pycnidia, ciliate lobe margins, and a mostly white medulla with yellow or buff coloring near the brown apothecia. Rudolph reported this as "*Parmelia quercina* (Willd.) Vain." (Mix 1954).

Ochrolechia arborea **(Kreyer) Almb., SAUCER LICHEN.** On *Acer rubrum* twig, Bog A (*HTR-118).* The thallus fluoresces orange in UV light.

Parmelia squarrosa **Hale, BOTTLEBRUSH SHIELD LICHEN.** Corticolous (Dirig 1989) and on dying *Acer rubrum* (*HTR-141)*, Bog A.

Parmelia sulcata **Taylor, HAMMERED SHIELD LICHEN.** Historically on *Acer saccharum,* 1945 (*Brown & Muenscher 383).* Also on unspecified woody substrates in 1984 (*L-1642* in NY) and 1989 (Dirig 1989), and on *Acer rubrum* in 2002 (*HTR-104, HTR-117, HTR-120)*, all in Bog A. On shrubs on mat in 1989 (*L-1652* in NY; Dirig 1989) and on wood lying on ground in open sun (*HTR-211)*, in Bog B. On *Picea abies* twigs (*HTR-163, HTR-174)*, sunny fence post (*HTR-173)*, and on fallen *Pinus strobus* branch (*HTR-102,* dupl. in FH), ROW. On fallen *Acer saccharum* branch in open sun, Old Field (*HTR-213).* On *A. rubrum* trunk, North Swamp (*HTR-255).* This species is ubiquitous throughout the Preserve.

Parmeliopsis capitata **R. C. Harris, *GLOBED STARBURST LICHEN.** On twigs of *Vaccinium corymbosum* (*L-1644, L-1649* in NY; Dirig 1989; *HTR-126, HTR-130, HTR-143;* and *HTR-156,* dupl. in FH) and on fallen *Acer rubrum* (*HTR-245)*, Bog A. This segregate is very similar to *P. ambigua* (Wulfen) Nyl., but has soredia in rounded heads primarily on the lobe tips.

Parmotrema margaritatum **(Hue) Hale, *PEARLY RUFFLE LICHEN.** Found on *Acer rubrum* in 1945 [*Brown & Muenscher 380;* Brown 1946:68, as "*Parmelia perlata* (L.) Ach."] and on *Betula alleghaniensis* (as *B* "*lutea*", Brown 1946:68). [Det. by R. C. Harris, 1981.]

Parmotrema stuppeum **(Taylor) Hale, POWDER-EDGED RUFFLE LICHEN.** On *Betula alleghaniensis* trunk, North Swamp (*HTR-164*).

Phaeophyscia pusilloides **(Zahlbr.) Essl., POMPON SHADOW LICHEN.** On *Acer saccharum,* Mud Pond basin (*HTR-182*).

Phaeophyscia rubropulchra **(Degel.) Essl., ORANGE-CORED SHADOW LICHEN.** Historically collected on *Ulmus americana* in 1944 (*Brown & Muenscher 160;* Brown 1946:75 — but one of her vouchers is *Anaptychia palmulata)* and on *Fraxinus nigra* in 1945 (*Brown & Muenscher 381;* Brown 1946:75), who also reported it [as "*Physcia endochrysea* (Hampe) Nyl."] on *Populus tremuloides, P. grandidentata, Juglans cinerea, Ostrya virginiana, Carpinus caroliniana, Betula alleghaniensis* (as *B.* "*lutea*"), *Alnus incana* ssp. *rugosa, Fagus grandifolia, Quercus bicolor, Acer saccharum, Tilia americana,* and *Fraxinus americana* (Brown 1946:75). During this survey, we found it on *Caprinus caroliniana* bark, Sphaerium Brook (*HTR-149*); on *Acer saccharum* near the Beaver Pond (*HTR-230*); on lower surface of large, angled *C. caroliniana* trunk, swamp south of Mud Pond (*HTR-202*); and on fallen dead bark in Bog A (*HTR-157,* dupl. in FH). This distinctive dark bluish-grey species with bright orange medulla is ubiquitous throughout the Preserve.

Physcia millegrana **Degel., MEALY ROSETTE LICHEN.** Found on *Acer saccharum* in 1952 (*Rudolph s.n.* in OS). On fence post (Dirig 1989; *HTR-197)* and *Picea abies* twigs (*HTR-179*), ROW; and on fallen trunk of large dead *A. saccharum* in full sun, Old Field (*HTR-215*), in 2002.

Physcia stellaris **(L.) Nyl., STAR ROSETTE LICHEN.** On fallen *Salix* sp. branch (*HTR-165, HTR-190)* and on *Acer negundo* bark (*HTR-185, HTR-192*), ROW; on twigs of *Cornus foemina* ssp. *racemosa* in open sun, edge of Old Field near Fen (*HTR-219*).

Physconia detersa **(Nyl.) Poelt., BOTTLEBRUSH FROST LICHEN.** On *Tilia americana* trunk in woods west of Sphaerium Brook corridor (*HTR-257*).

Porpidia albocaerulescens **(Wulfen) Hertel & Knoph, PEARL BUTTON LICHEN.** On seasonally shaded acidic erratic beside footpath on southwestern corner of Mud Pond basin (*HTR-236);* another thallus observed on a rock beneath *Tsuga canadensis* in the Sphaerium Brook corridor. The black-rimmed, pruinose, cerulean apothecia on a pale saxicolous crustose thallus immediately distinguish this species.

Psilolechia lucida **(Ach.) M. Choisy, SULPHUR DUST LICHEN.** On shaded rocks, Rock Pile near Fen, with slightly paler, convex apothecia (Dirig 1989; *HTR-100*); also saxicolous in Rock Pile at base of Inlet Meadow, under *Pinus strobus* (observed but not collected, 2002). This bright chartreuse, sorediate species usually grows on damp, north-facing (thus shaded) rocks, and fluoresces brilliant orange under UV light.

***Punctelia rudecta* (Ach.) Krog, ROUGH SHIELD LICHEN.** Brown (1946:71) recorded this common species (as "*Parmelia rudecta* Ach.") from *Populus grandidentata, Carpinus caroliniana, Betula alleghaniensis* (as *B.* "*lutea*"), *Alnus incana* ssp. *rugosa, Fagus grandidentata, Quercus bicolor, Ulmus americana, Prunus serotina, P. virginiana, Toxicodendron vernix, Acer rubrum, A. saccharum, Tilia americana,* and *Fraxinus nigra* at McLean. During our survey found on tree bark near the Shack and in the Sphaerium Brook corridor (Dirig 1989); and on *Acer rubrum,* Bog A (*HTR-114, HTR-139*). This common lichen grows on trees along forest edges and in woodland openings throughout the Preserve.

***Punctelia subrudecta* (Nyl.) Krog, FOREST SPECKLEBACK.** Corticolous in 1984 (*L-1640* in NY), and on dead (*HTR-113; HTR-155,* dupl. in FH) and living (*HTR-144*) *Acer rubrum,* Bog A; on *A. rubrum* bark (*HTR-208, HTR-170*) and downed *Pinus strobus* branch (*HTR-167*), Bog B; and on *Picea abies* twigs, ROW (*HTR-178*). This sorediate species seems to be slightly more common than the very similar but isidiate *P. rudecta* in the Preserve. Some of Brown's (1946:71) records for *P. rudecta* might refer to this species (there are no vouchers).

***Pyxine sorediata* (Ach.) Mont., SPOTTED BLISTER LICHEN.** Found on *Acer rubrum* bark in 1952 (*Rudolph s.n.* in OS), mixed with *Myelochroa galbina*. The pale yellow-orange medulla, white lobe margins, and largely marginal soredia distinguish this subtle species, which Rudolph reported as "*Parmelia quercina* (Willd.) Vain." (Mix 1954).

***Ramalina pollinaria* (Westr.) Ach., CHALKY RAMALINA.** Historically collected from an *Ulmus americana* trunk in an alder swamp in 1944 (*Brown & Musencher 5;* Brown 1946:80, 166; Brown 1948:465). This important record was confirmed using TLC by S. LaGreca.

***Trapeliopsis viridescens* (Schrader) Coppins & P. James, *JADE CARPET LICHEN, GREEN SMEAR LICHEN.** On roots of a fallen *Tsuga canadensis* in dappled shade (sterile), Bog B (*HTR-248, HTR-252*).

***Trypethelium virens* Tuck. *ex* Michener, GREENISH WAX LICHEN.** In company with *Graphis scripta* on a dead *Carpinus caroliniana,* Argus Brook (*HTR-171-A*).

***Tuckermannopsis sepincola* (Ehrh.) Hale, CHOCOLATE LICHEN.** Historically abundant on shrubs invading the open mat of Bog B in 1977 (*L-1655* in NY, NYS, R.D.) and in 1984-1989 (Dirig 1989), but apparently not in Bog A. The largely closed mat of Bog B was re-opened in 2000 by cutting out the brush and invading trees, but we failed to find *T. sepincola* there during this survey. If it persists anywhere in the canopy, it may reappear as young shrubs repopulate the mat.

Usnea hirta **(L.) F. H. Wigg., BRISTLY BEARD LICHEN.** Corticulous in Bog A (*L-1636* in NY). [Det. by R. C. Harris.]

Usnea strigosa **(Ach.) Eaton, BUSHY BEARD LICHEN.** On tree at breast height (*L-1645)*, on twigs of *Vaccinium corymbosum* (*HTR-116)*, and a large mass on *Acer rubrum* (*HTR-237)*, in Bog A. All contain usnic acid and an "*Usnea arizonica* unknown aryl" (LaGreca annotations), a compound also reported from an *Usnea* specimen collected in the Shawangunk Mountains, Ulster County, NY (Dirig 1994:546).

Usnea cf. subfloridana **Stirton, OLD MAN'S BEARD.** On woody substrate in Bog B (*HTR-184)*. Although containing usnic and squamatic acids (TLC), this specimen is esorediate. S. LaGreca (letter to us, 28 Aug. 2002) suggested that "perhaps this specimen simply lacked soredia, for some reason," and we have tentatively placed it in *subfloridana*.

[*Usnea* **spp.** Several other specimens of this very difficult genus await determination: *L-1645* and *L-1654* in NY; *Brown & Muenscher 4a, L-7539, L-7553, HTR-111,* and *HTR-229* in CUP.]

Vulpicida pinastri **(Scop.) J.-E. Mattsson & M. J. Lai, PINE LICHEN, POWDERED SUNSHINE.** At base of *Acer* sp. at edge of floating open mat (Dirig 1989), and on twigs of *Vaccinium corymbosum* in moat (*L-1648* in NY, NYS; *HTR-112, HTR-127, HTR-136)*, all Bog A. Conspicuously growing on shrubs on open mat in 1977 (*L-1651* in FH, NY, NYS, R.D.), still abundant there 1984-1989 (Dirig 1989), and on dead branches on ground (*L-7512)* and on *Tsuga canadensis* (*HTR-177)* in 2001-2002, all Bog B. This brilliant yellow sorediate lichen is a boreal relict, and one of McLean's biotic treasures.

Xanthoparmelia plittii **(Gyelnik) Hale, PLITT'S ROCK-SHIELD, PLITT'S BOULDER LICHEN.** Saxicolous in Rock Piles near the Fen (*HTR-242)* and Inlet Brook (*L-7540)*. This isidate species is tan or brown beneath.

Xanthoparmelia somloënsis **(Gyelnik) Hale, SHINGLED ROCK-SHIELD.** Saxicolous in Rock Pile near Fen (*HTR-232)* and on rock in shrub zone between Old Field and Fen, beneath *Cornus foemina* ssp. *racemosa* and *Rubus* sp. (*HTR-220)*. This species has non-isidate thalli that are pale beneath.

DISCUSSION

OUR SURVEY WAS PRELIMINARY, and focused on macrolichens (many more microlichens remain to be collected and studied at McLean). We documented 66 species from the Preserve, of which 51 were found there for the first time in 2002.

SUMMARY OF THE MCLEAN LICHEN FLORA

Many of McLean's lichens are widespread and well known, but a few are locally scarce. *Anaptychia palmulata, Bryoria furcellata, Cladonia scabriuscula, Parmeliopsis capitata, Parmotrema stuppeum, Trapeliopsis viridescens,* and

Vulpicida pinastri are especially interesting or noteworthy species that presently grow in the Preserve.

We made focused searches for *Cetrelia olivetorum, Lobaria pulmonaria, Ramalina pollinaria,* and *Tuckermannopsis sepincola,* but did not rediscover any of these historical species; nor did we chance to find *Lithothelium hyalosporum, Melanelia fuliginosa, Myelochroa galbina, Parmotrema margaritatum,* or *Pyxine sorediata,* although they had been found by Brown (1946) and Rudolph (OS vouchers) between 1944-1952. Among the 15 previously known species, *Anaptychia palmulata, Cladonia furcata, Evernia mesomorpha, Graphis scripta, Hypogymnia physodes, Parmelia sulcata,* and *Phaeophyscia rubropulchra* were still present in 2002.

We also sought but did not find *Platismatia tuckermanii* (Oakes) W. Culb. & C. Culb., *Pseudevernia consocians* (Vainio) Hale & W. Culb., and members of the *Tuckermannopsis ciliaris* (Ach.) Gyelnik group, which all might be expected in bogs, but have never been recorded from McLean.

Brown (1946) listed six additional McLean lichens, for which there appear to be no vouchers [modern synonyms are from Esslinger (1997-2002)]: **1.** "*Lecidea vernalis* (L.) Ach.," now called *Biatora vernalis* (L.) Fr., on *Ulmus americana, Acer rubrum,* and *Tilia americana* [p. 61]. This was probably *Biatora longispora* (Degel.) Printzen, which is "weedy" and likely to be still there, according to R. C. Harris (*pers. comm.* 2003). **2.** "*Leptogium tremelloides* (L.) S. F. Gray," presently called *L. cyanescens* (Rabenh.) Körber, on *Acer rubrum* [p. 62]. **3.** "*Parmelia olivacea* (L.) Ach.," now *Melanelia olivacea* (L.) Essl., on a dozen species of trees [p. 66], perhaps also including *M. subaurifera* and other *Melaneliae* (R. C. Harris, *pers. comm.* 2003). **4.** *Peltigera canina* (L.) Willd. on *Quercus bicolor* and *Fraxinus americana* [p. 72]. **5.** "*Physcia astroidea* (Clem.) Nyl." on *Ulmus americana* [p. 74], probably referring to *P. millegrana* (R. C. Harris, *pers. comm.* 2003). And **6.** *Pyrenula nitida* (Weig.) Ach. on *Fagus grandifolia* and *Acer saccharum* [p. 78], which, according to Esslinger (1997-2002), has been misidentified in North America; R. C. Harris (*pers. comm.* 2003) suggested that this is almost certainly *P. pseudobufonia* (Rehm) R. C. Harris. We searched for *Peltigera* and *Leptogium* spp. at McLean without finding any, but Brown's records of these two genera are probably accurate. The other four remain uncertain or ambiguous without specimens, but are included here as historical footnotes.

Brown (1946) seems to have had a broader concept of the McLean Bogs Preserve than we do today — probably based on the habitat map in Scientific Staff of Cornell University (1926:8) — since all of her CUP vouchers are from Cortland County, which abuts the eastern boundary of the tract. Brown (1946) reported three additional lichens growing on Tamarack (*Larix laricina)* and/or Black Spruce (*Picea mariana)* at McLean: "*Cetraria aurescens* Tuck.," now *Ahtiana aurescens* (Tuck.) Thell & Randlane [p. 51]; "*Cetraria ciliaris* Ach.," now *Tuckermannopsis ciliaris* [p. 52]; and "*Usnea barbata* (L.) Wigg.," which has been widely misidentified in North America, according to Esslinger (1997-2002) [p. 82]. (We found no specimens.) These records probably came from the "Woodwardia Bog near McLean, Tompkins County," which she gave as a locality on other specimens.

Woodwardia Bog is east of Freeville, ca. 4 miles (6.4 km) southwest of the Preserve, where both of these regionally rare (Wiegand & Eames 1926:42) bog conifers still occur (F. R. Wesley, D. Werier, *pers. comm.* 2003). Reports of lichens on Tamarack or Black Spruce at McLean are in error, as these trees have never been found in the Preserve.

LICHEN HABITATS

Human-altered habitats are quite limited in the Preserve, but their available substrates have been readily colonized by lichens that tend to favor disturbance (Table 1). The best colonizers — *Arthonia caesia, Candelaria concolor, Candelariella efflorescens, Flavoparmelia caperata, Flavopunctelia flaventior, Lecanora symmicta, L. thysanophora, Physcia millegrana, P. stellaris,* and *Punctelia subrudecta* — are all sorediate, with the exception of isidiate *Punctelia rudecta*. These common species may occupy a wider range of habitats than we have recorded here, since we stopped collecting them early in the survey.

We found very few lichens in mature woodlands. Much richer assemblages occurred along forest edges or in open wetland habitats with deciduous trees (and thus seasonal dappled shade), as summarized in Table 1.

The richest wet lichen habitats were the bogs, but swamps also harbored many species. Fewer lichens grew along stream corridors, in the shrub-swamps, and around the Beaver Pond, probably due to their shorter-lived woody and herbaceous substrates and more changeable shade and humidity regimes (via intermittent flooding from Beaver activity).

Lichens having very specific microhabitats in the Preserve (detailed in the species accounts above) include *Acarospora fuscata, Chaenotheca furfuracea, Hypocenomyce scalaris, Imshaugia aleurites, Psilolechia lucida,* and *Porpidia albocaerulescens*.

Bryoria furcellata, Cetrelia olivetorum, Chaenotheca furfuracea, Evernia mesomorpha, Hypogymnia physodes, Imshaugia aleurites, Lobaria pulmonaria, Parmeliopsis capitata, *Parmotrema* and *Usnea* spp., and *Vulpicida pinastri* are characteristic of bogs and cool swamps at this latitude, with *B. furcellata, H. physodes, P. capitata,* and *V. pinastri* restricted to bog mats at McLean.

PHYTOGEOGRAPHIC AFFINITIES

Among McLean's lichens, *Cladonia coniocraea, C. furcata, C. macilenta, C. pyxidata, C. scabriuscula, Evernia mesomorpha, Hypogymnia physodes, Imshaugia aleurites, Lecanora symmicta*, *Melanelia subaurifera, Parmelia squarrosa, P. sulcata*, *Parmeliopsis ambigua* (presumably including *P. capitata)*, *Ramalina pollinaria, Tuckermannopsis sepincola, Usnea hirta, U. subfloridana,* and *Vulpicida pinastri* have boreal and "low arctic" affinities (Brodo 1968:80, Thomson 1984:5, Gowan & Brodo 1988:268). Many of these may be Pleistocene relicts that have persisted in the constantly damp, shaded, conifer-dominated, relatively cooler microclimates of bogs and swamps at this latitude. Most of the remaining lichens on the McLean list have primarily temperate distributions (Brodo 1968:81-82, Gowan & Brodo 1988:268).

Table 1: McLean Lichen Habitat Summary

ROCKS

Rock Piles: *Acarospora fuscata, Cladonia cryptochlorophaea, C. macilenta, Lecidea tessellata, Psilolechia lucida, Xanthoparmelia plittii, X. somloënsis*

Acidic Erratics: *Cladonia cryptochlorophaea, Porpidia albocaerulescens*

DISTURBED SITES

Open Early-successional Vegetation: *Cladonia furcata, C. scabriuscula, Xanthoparmelia somloënsis*

Dry Shrubs/Fence Posts (ROW, Gravel Pit, and Other Disturbed Situations): *Arthonia caesia, Caloplaca cerina, C. holocarpa, Candelaria concolor, Candelariella efflorescens, Cladonia furcata* (on ground), *C. scabriuscula* (on ground), *C. pyxidata* (on rock), *Flavoparmelia caperata, Lecanora symmicta, Melanelia fuliginosa, Parmelia sulcata, Physcia millegrana, P. stellaris, Punctelia subrudecta*

WOODLANDS

Steep Upland Woods: *Cladonia parasitica, Graphis scripta, Lithothelium hyalosporum, Porpidia albocaerulescens* (on rock)

Sunlit Trees: *Candelaria concolor, Candelariella efflorescenes, Flavopunctelia flaventior, Parmelia sulcata, Physcia millegrana*

Fence Lines: *Hypocenomyce scalaris, Punctelia rudecta*

WETLANDS

Bogs: *Allocetraria oakesiana, Arthonia caesia, Bryoria furcellata, Candelariella efflorescens, Cladonia caespiticia, C. coniocraea, C. cylindrica, C. macilenta* and its var. *bacillaris, Evernia mesomorpha, Flavoparmelia caperata, Flavopunctelia flaventior, Fuscidia arboricola, Graphis scripta, Hypogymnia physodes, Hypocenomyce scalaris, Imshaugia aleurites, Lecanora thysanophora, Lepraria lobificans, Melanelia subaurifera, Ochrolechia arborea, Parmelia squarrosa, P. sulcata, Parmeliopsis capitata, Phaeophyscia rubropulchra, Punctelia rudecta, P. subrudecta, Tuckermannopsis sepincola, Usnea hirta, U. strigosa, U. cf. subfloridana, Vulpicida pinastri*

Swamps: *Anaptychia palmulata, Cetrelia olivetorum, Chaenotheca furfuracea, Graphis scripta, Lecanora thysanophora, Lobaria pulmonaria, Melanelia subaurifera, Parmelia sulcata, Parmotrema margaritatum, P. stuppeum, Phaeophyscia pusilloides, P. rubropulchra, Ramalina pollinaria, Trapeliopsis viridescens*

Shrub-swamps: *Arthonia caesia, Candelariella efflorescens, Cladonia ochrochlora, C. ramulosa, Graphis scripta, Myelochroa aurulenta*

Stream Courses: *Arthonia caesia, Candelariella efflorescens, Flavoparmelia caperata, Graphis scripta, Melanelia subaurifera, Phaeophyscia rubropulchra, Physconia detersa, Porpidia albocaerulescens, Punctelia rudecta, Trypethelium virens*

Beaver Pond: *Anaptychia palmulata, Chaenotheca furfuracea, Cladonia caespiticia, C. coniocraea, Flavoparmelia caperata, Flavopunctelia flaventior, Lecanora thysanophora, Myelochroa aurulenta, Phaeophyscia rubropulchra*

Table 2: Substrates of Corticolous and Lignicolous McLean Lichens

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CORTICOLOUS SPECIES

Acer negundo: *Candelaria concolor, Physcia stellaris*

Acer rubrum: *Allocetraria oakesiana, Arthonia caesia, Cladonia cylindrica, Evernia mesomorpha, Flavoparmelia caperata, Flavopunctelia flaventior, Fuscidia arboricola, Hypogymnia physodes, Lepraria lobificans, Melanelia subaurifera, Myelochroa galbina, Ochrolechia arborea, Parmelia squarrosa, P. sulcata, Parmeliopsis capitata, Parmotrema margaritatum, Punctelia rudecta, P. subrudecta, Pyxine sorediata, Usnea strigosa*

Acer saccharum: *Candelaria concolor, Candelariella efflorescens, Flavopunctelia flaventior, Lecanora thysanophora, Lithothelium hyalosporum, Parmelia sulcata, Phaeophyscia pusilloides, P. rubropulchra, Physcia millegrana*

***Acer* sp. :** *Vulpicida pinastri*

Alnus incana* ssp. *rugosa: *Arthonia caesia, Physcia stellaris*

Betula alleghaniensis: *Cetrelia olivetorum, Graphis scripta, Parmotrema stuppeum*

Carpinus caroliniana: *Candelariella efflorescens, Flavoparmelia caperata, Graphis scripta, Melanelia subaurifera, Myelochroa aurulenta, Phaeophyscia rubropulchra, Trypethelium virens*

Cornus foemina* ssp. *racemosa: *Arthonia caesia*

Fraxinus nigra: *Graphis scripta, Phaeophyscia rubropulchra*

***Fraxinus* sp.:** *Anaptychia palmulata, Flavoparmelia caperata, Lecanora thysanophora, Myelochroa aurulenta*

Ilex verticillata: *Graphis scripta*

Picea abies: *Flavoparmelia caperata, Lecanora symmicta, Physcia millegrana, Punctelia subrudecta*

Pinus strobus: *Bryoria furcellata, Hypocenomyce scalaris, Hypogymnia physodes, Imshaugia aleurites* (dead), *Parmelia sulcata, Punctelia subrudecta*

***Populus* sp.:** *Caloplaca cerina, C. holocarpa, Candelariella efflorescens*

Prunus serotina: *Evernia mesomorpha, Hypocenomyce scalaris*

Prunus virginiana: *Melanelia fuliginosa*

***Salix* sp.:** *Physcia stellaris*

"shrubs": *Tuckermannopsis sepincola*

Tilia americana: *Physconia detersa*

Tsuga canadensis: *Allocetraria oakesiana, Bryoria furcellata, Chaenotheca furfuracea* (on soil on roots), *Cladonia coniocraea* (on fallen log), *Hypocenomyce scalaris* (on dead tree), *Hypogymnia physodes, Trapeliopsis viridescens* (on soil on roots), *Vulpicida pinastri*

Ulmus americana: *Lobaria pulmonaria, Phaeophyscia rubropulchra, Ramalina pollinaria*

***Ulmus* sp.:** *Anaptychia palmulata*

Vaccinium corymbosum: *Allocetraria oakesiana, Imshaugia aleurites, Melanelia subaurifera, Parmeliopsis capitata, Usnea strigosa, Vulpicida pinastri*

Viburnum nudum* var. *cassinoides: *Graphis scripta*

Table 2: Substrates of Corticolous and Lignicolous McLean Lichens (continued)

LIGNICOLOUS SPECIES

dead wood/stump: *Arthonia caesia, Cladonia macilenta, C. ochrochlora, Evernia mesomorpha, Hypogymnia physodes, Lepraria lobificans,*

fence post: *Candelariella efflorescens, Physcia millegrana*

fallen/dead branch: *Candelariella efflorescens, Evernia mesomorpha, Flavopunctelia flaventior, Parmelia sulcata, Vulpicida pinastri*

fallen tree/log: *Cladonia caespitica, C. coniocraea, C. parasitica, C. ramulosa*

SUBSTRATES

The very limited rock and soil substrates in the Preserve surprised us. We collected only eight saxicolous (Table 1), two terricolous (*Cladonia furcata, C. scabriuscula)*, and two hummock-dwelling lichens (*C. macilenta* var. *bacillaris* and *Trapeliopsis viridescens);* all the other species were growing on bark or lignum. To complement Brown's (1946, 1948) historical records of epiphytes, we present a substrate summary for tree-dwellers in Table 2. A wide variety of woody plants serves as lichen substrates at McLean. *Acer rubrum* supports the highest number of lichens (20 species), with *A. saccharum* and *Tsuga canadensis* also hosting relatively rich lichen assemblages (9 and 8 species, respectively).

SUCCESSIONAL, NATURAL, AND HUMAN-GENERATED CHANGES

Dirig's field observations at McLean over the past 25 years suggest that vegetational succession is a very powerful natural force in shading and altering lichen habitats. The current near absence of formerly abundant *Cladonia furcata* from the ROW, Inlet Meadow, and Old Field is one example; while the apparent disappearance of *Tuckermannopsis sepincola* from Bog B during the past decade makes us wonder what happens to boreal lichen relicts when bog mats close through succession? Do they linger in the canopy for a time, then eventually die out? How will the recent cutting of trees and shrubs on the Bog B mat affect *T. sepincola* and other bog lichens?

Mature American Elms (*Ulmus americana)* died throughout the Preserve between 1968-1972*ff.*, due to Dutch Elm Disease. Loss of this important wetland tree has undoubtedly affected a whole guild of associated epiphytes, including several lichens. (Two of McLean's scarcest species, *Lobaria pulmonaria* and *Ramalina pollinaria,* grew on *U. americana* in the 1940s.) Interestingly, large living Slippery Elms (*U. rubra)*, which are not affected by this disease, seem to bear few lichens on their bark. Many mature American Beeches (*Fagus grandifolia)* have likewise died and fallen at McLean after infection with Beech Bark Disease during the past 20 years. Mature Beech trees typically do not support an extensive lichen flora, but this change in forest composition will certainly affect any associated lichens. It may also subtly alter the distribution of lichens in the surrounding woods as light enters a new clearing when the dying Beech loses its leaves and eventually collapses.

Lichen floras are dynamic, with some species dropping out and others becoming established as time passes, depending on their specific microhabitat requirements, in combination with human influences. Our preliminary study establishes a baseline for observing and recording future changes in the local lichen flora.

Re-flooding of the mouth of Sphaerium Brook and the adjacent Shrub-swamp by Beavers (*Castor canadensis)* in autumn 1999 was unfortunate in its timing, as it precluded our examining standing dead trees in this corner of the Preserve for lichens. These trees died in 1980-1981 during an earlier cycle of Beaver occupation, and have more recently stood in an old beaver meadow. Additional corticolous and lignicolous lichens may grow on them, but the habitat is presently inaccessible, except by boat. These need to be examined for lichens after the current pond subsides. Further fieldwork with McLean lichens might also include searching the upper trunks, branches, and canopies of trees in various habitats, and thoroughly inventorying the crusts, which were largely beyond the scope of our study. We hope that this annotated list of lichens from a famous mycological site in the Finger Lakes Region of central New York will catalyze further prospecting for these intriguing and little-known organisms.

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Edward A. Cope (BH), **Richard C. Harris** (NY), LaGreca, Ostman, Werier, and Wesley read a draft of this paper and offered valuable suggestions.

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MYCOTAXON

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A NEW SPECIES OF PSEUDOROBILLARDA FROM AN ASPARAGUS FIELD IN QUEBEC, CANADA

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ABSTRACT

A new species of coelomycetes in genus *Pseudorobillarda* is described and illustrated. *Pseudorobillarda asparagis* sp. nov. is a saprophyte isolated from the soil litter of an asparagus field in Quebec, Canada. This fungus is typical of the genus in morphology, but clearly different from other known species in *Pseudorobillarda* by distinct size and form of conidiomata and paraphyses, and by shape, size, and colour of conidia. Its taxonomic placement is discussed.

Key Words: *Pseudorobillarda asparagis*, coelomycetes, systematics

RÉSUMÉ

Les auteurs décrivent une nouvelle espèce, le *Pseudorobillarda asparagis*, qui a été isolée de débris de la litière du sol d'un champ d'asperges au Québec, Canada. Le champignon possède tous les caractères typiques de ce genre, mais il diffère des autres espèces par la forme conidiomatale, les paraphyses, ainsi que par la forme, la couleur et la largeur des conidies. La position taxonomique de cette espèce est discuté.

Mots clés: *Pseudorobillarda asparagis*, coelomycète, systématique

INTRODUCTION

During a study of the mycobiotic biodiversity in asparagus fields of the Québec province, Canada, a species of *Pseudorobillarda* M. Morelet was isolated from the soil litter and decomposing foliage of one unidentified plant. The isolate was compared with the nine species of *Pseudorobillarda* in Nag Raj (1993) and the species described by Bianchinotti (1997). We determined that this isolate was distinct and describe it here as a new species.

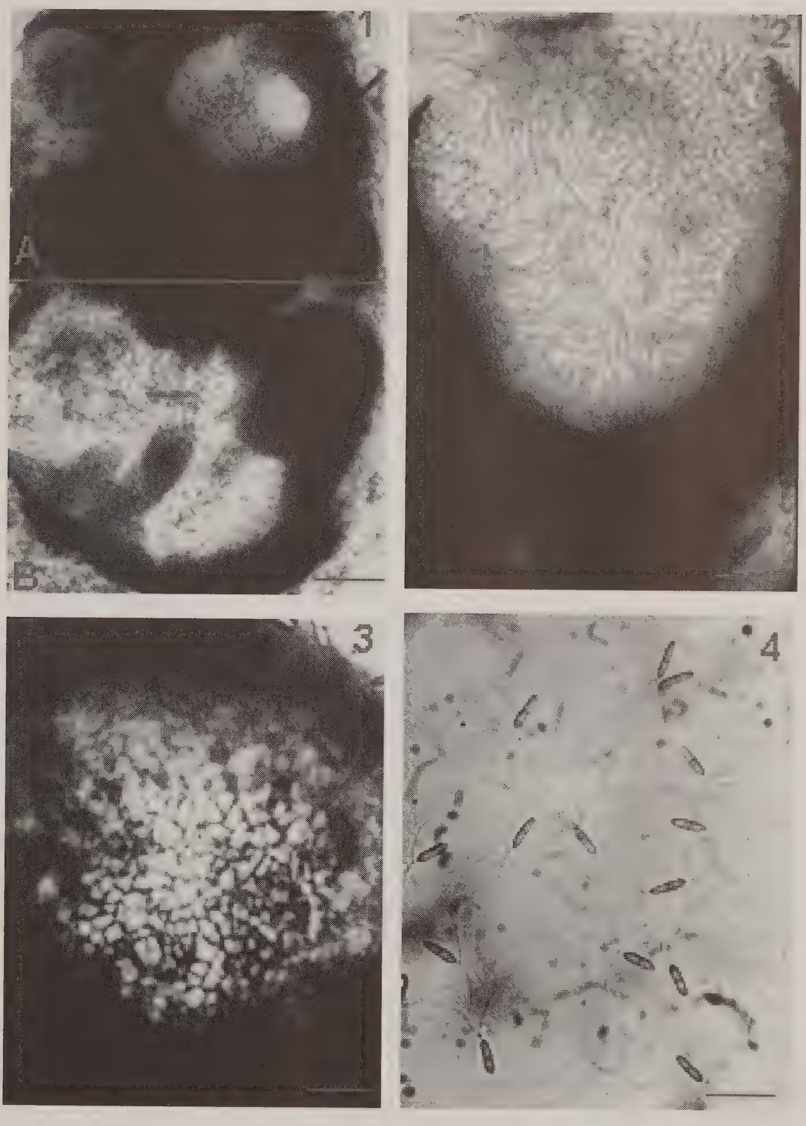
MATERIAL AND METHODS

In October 2001, we searched for mycobiota in the litter of asparagus fields throughout Québec. From the site in this study, loc. Joliette (Québec), we isolated one *Pseudorobillarda* species on PDA plates [2% potato-dextrose agar supplemented with Streptomycin sulphate (Sigma, St-Louis, MO, USA, 100mg/l) and Neomycin sulphate (Sigma, St-Louis, MO, USA,12 mg/l)], incubated 4 weeks in the darkness at 21°C (±1). For microscopic examinations, fertile fungal structures were obtained on PDA plates after four weeks of growth. Ten conidiomata and 50 conidia from each conidiomata were measured. Observations, photographs, and measurement of conidiogenous cells and conidia were made in water, while appendages were stained using Leifson's modified technique (Punithalingam, 1989). Radial growth was measured in two axes every 24 h over a 1-wk period, using plates incubated at 21°C (±1) in darkness. Growth rates are averages of three replicates.

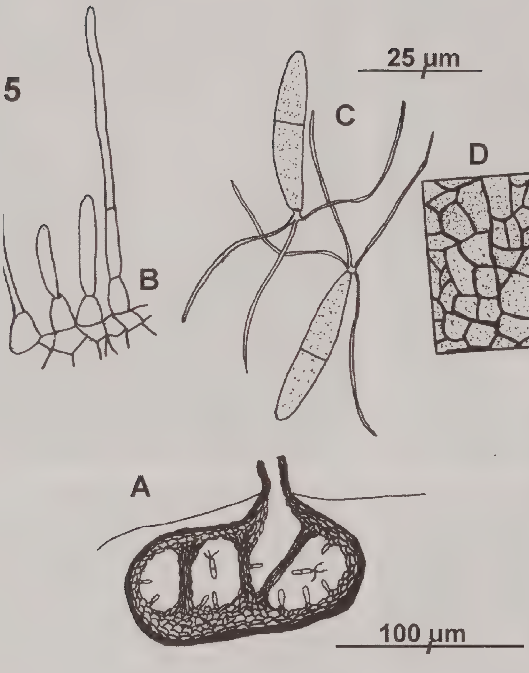
TAXONOMY

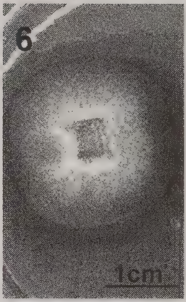
Pseudorobillarda asparagis VUJANOVIC anam. sp. nov. FIGURES 1-7

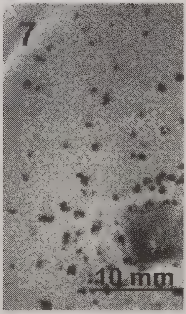
Conidiomata pycnidialia, solitaria vel aggregaria, immersa vel semi-immersa, unilocularia vel multilocularia, globosa vel irregularia, atrobrunnea, 100-500 µm lata, ostiolata ; ostiola circularia vel ovalia, 40-80 µm diam.; pariete 20-80 µm cr., ex externa textura prismatica, cellulis tenuitunicatis crassitunicatis, atrobrunneis vel brunneis, et interna textura angulari, cellulis pallescentibus. Conidiophora absentia. Cellulae conidiogenae discretae, cylindricae, circum cavitatem distributia, hyalinae, cum paraphysibus mixtae, in muco involutae, 2-10 x 2-2.5 µm. Paraphyses hyalinae, filiformes vel irregulares, 1-8 septatae (10-40 µm long.), laeves basi leniter inflata 1-3 µm lat., apice 1-4 µm lat. Conidia bicellularia, hyalina vel pallide-brunnea, fusiformia, in apice sub-acuta, base angusta et acuta, laevia, 10-14 x 2.0-2.5 µm, appendices 3-4 flexibiles ad apicem ferentes, 15-33 µm longas; ratione conidii long./lat.: 5.2: 1. Coloniae super substratum 'potato-dextrosum' tenues, ad 0.7 cm in una die 21°C crescentes. Mycelium denso-aerium, griseum, subimmersum in substratum, marginae regulari. Hyphae hyalinae vel brunneae,septatis, 2-6 µm cr.



Figures 1-4. *Pseudorobillarda asparagis*, HOLOTYPE (UAMH 10196) on PDA: Fig 1. Vertical section of A.) unilocular and B.) multilocular ostiolate (arrows) conidioma, Scale bar = 25 µm; Fig 2. Sterile conidioma showing paraphyses, Scale bar = 15 µm; Fig 3. Parietal cells and conidioma, Scale bar = 20 µm; Fig 4. Mature conidia, Scale bar = 20 µm







Figures 5-7. *Pseudorobillarda asparagis*, HOLOTYPE (UAMH 10196) on PDA: 5A.) Vertical section of conidioma, 5B.) Partial sectional view of hymenium showing paraphyses and conidia in formation, 5C.) Mature conidia showing appendages, and 5D.) Enlarged surface view of parietal cells; 6.) Fungal colony after 1 week on PDA; 7.) Enlarged view of colony surface showing conidiomata.

Conidiomata pycnidial, scattered or aggregated, globose to depressed globose, immersed to semi-immersed, 100-500 µm diam., dark-brown, uni- to multilocular, wall up to 80 µm thick, comprised of an outer *textura prismatica* with thick-walled dark brown to brown cells and an inner *textura angularis* with thin-walled paler cells; ostiolate, ostiole 40-80 µm diam. *Conidiophores* reduced to conidiogenous cells. *Paraphyses* filiform, unbranched, in fertile conidiomata intermixed with conidiogenous cells, non-septate or 1-septate, hyaline, 10-25 x 2.0-2.5 µm long; or irregular in sterile conidiomata, 2-8 septate, 25-45 x 2.5-4.5 long. *Conidiogenous cells* short, cylindrical, ampulliform, colourless, lining the cavity of the conidioma, invested in mucus, smooth, 5-8 x 2-5 µm. *Conidiogenesis* holoblastic, secession schizolytic; proliferation enteroblastic to produce subsequent conidia. *Conidia* formed inside a sheath, bicellular, sometimes constricted at the septa, colourless or slightly yellowish, fusiform, apex subacute, base blunt, smooth, 10-14 x 2.0-2.5 μm (Mean l/w ratio: 5.2) bearing at one end mostly 3 or 4 divergent, unbranched, flexuous, extracellular appendices, 15-33 μm long. *Colony* diameter increased 0.7 cm per day on PDA at 21°C and mature pycnidia were produced in less than three weeks. *Mycelium* superficial or slightly immersed and fertile in culture, dense-cottony, radial with regular margin; grey to grey-white in colour, reverse brown. Hyphae septate, hyaline to brownish, 2-6 μm diam.

KNOWN DISTRIBUTION: Quebec, Canada

TELEOMORPH: Unknown

HOLOTYPE. CANADA. Québec, Joliette, on decomposing leaf of an unidentified plant in asparagus field, 16.X. 2001, Vujanovic, UAMH 10196.

DISCUSSION

Species in *Pseudorobillarda* are saprophytes or endophytes on leaves and stems of Monocotyledons and Dicotyledons (Kiffer and Morelet 1997; Uecker and Kulik 1986). *Pseudorobillarda*, as defined by Nag Raj (1972), produces conidiomata which bear a definite ostiole, conidiophores arising all around the cavity of conidiomata mixed with simple or branched paraphyses (invested in mucus), conidium ontogeny is enteroblastic, conidia are uniseptate or occasionally multiseptate with divergent appendages at one end. Eight species were retained in *Pseudorobillarda*, until today. Nag Raj (1993) initially accepted eight species (*P. agrostis*, *P. bambusae*, *P. jaczewski*, *P. indica*, *P. phragmitis*, *P. setarie*, *P. sojae* and *P. texana*), Bianchinotti (1997) added one species (*P. magna*), and Abbas et al. (2002) transferred *P. sojae* to a new *Stauronematopsis* Abbas, Sutton & Ghaffar genus. Species in this genus are separated mainly by the presence or absence of paraphyses and by conidial features (Nag Raj 1993). This taxon was included in *Pseudorobillarda* because its characteristics agree with those of the genus (Nag Raj et al. 1972; Uecker and Kulik 1986). *Pseudorobillarda asparagis* can be distinguished from all species in this genus by the simultaneous production of fertile (Fig 1.) and sterile conidiomata (Fig 2.) on the cultural medium. The hymenium of sterile conidiomata bears exclusively the paraphysate cells which size and septation vary greatly from those in the fertile conidiomata. The multilocular conidiomata (Fig 7A), as well as shape, dimension and colour of conidia also distinguish this species from other species in this genus. Furthermore, the new proposed species differs from the most similar species, *P. agrostis* and *P. bambusae* (TABLE I), by the conidia colour and l/w ratio, as well as by the colony form and colour. Moreover, the combination of the number of paraphyses' septa and length of appendages are different. These characteristics are also of diagnostic importance as has been proposed by Bianchinotti (1997).

Table 1. Features differentiating *Pseudorobillarda asparagis, P. agrostis* and *P. bambusae*

Characters	*P. asparagis*	*P. agrostis*	*P. bambusae*
Conidial characters			
Shape	Fusiform	Fusiform	Subcylindrical to fusiform
Colour	Yellowish	Hyaline	Hyaline
Number of septa	1	1	1
Length (μm)	10-14	13-20	17-23
Width (μm)	2.0-2.5	2.0-3.0	2.5-3.5
Mean l/w ratio	5.2 : 1	6.6 : 1	6.5 : 1
Appendages			
Number	3-4	3-4	2-3
Length (μm)	up to 33	up to 16.5	up to 22
Paraphyses			
Septation	1-8	0-2	1-6
Length (μm)	15-33	28-52	20-35
Colony colour	Grey to brown	Unknown	White
Host	Unidentified in soil litter	*Agrostis tenuis* *Muhlenbergia filiformis* *Lathyrus sylvestris*	*Bambusa* sp.
Specimen location	Canada	Germany, USA	India

ACKNOWLEDGMENTS

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MYCOTAXON

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NEW OR FORGOTTEN HELOTIALES FROM GREENLAND 1. DERMATEACEAE AND HYALOSCYPHACEAE

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ABSTRACT: A new genus of the Dermateaceae, *Sarconiptera*, three new species of the Dermateaceae, *Belonopsis eriophori, Diplonaevia latispora* and *Sarconiptera vinacea* are described, and a new combination *Leptotrochila axillaris* is made. Nine new species of the Hyaloscyphaceae, *Amicodisca groenlandica, Arachnopeziza groenlandica, Calycina ovalipilosa, Lachnum arcticum, Lachnum uliginosum, Mollisina groenlandica, Psilocistella alchemillae, Psilocistella macrospora* and *Solenopezia groenlandica* are described.

Key words: taxonomy, new genus, new species, arctic distribution

INTRODUCTION

The Pezizales of Greenland are comparatively well investigated (Dissing, 1982) but the inoperculate discomycetes of this highly interesting arctic area are more poorly known and there is no modern comprehensive account. The author started to prepare a critical check-list of Helotiales of Greenland in collaboration with Henning Knudsen (Copenhagen), studying the earlier collections in C during two visits to Botanical Museum, University of Copenhagen in 2000 and 2002, and collecting Helotiales in Greenland during ISAM 6 in 2000. In the course of these studies a number of new species and also some species known to Rostrup but forgotten by later authors were discovered. *Pseudopeziza axillaris* Rostr. is revived and reassessed as *Leptotrochila axillaris*.

MATERIAL AND METHODS

This study is based on critical revision of collections from Greenland deposited in C and collections made during ISAM 6 held in Greenland in August 2000 by the author and other participants of this symposium. The dry material was rehydrated in a 2% aqueous solution of KOH. Melzer's reagent (MLZ), 1% I_2, 3% KI Lugol's solution (IKI), ammoniacal Congo Red (CR) and 0.15% Cotton Blue in lactic acid (CB) were used for histochemical reactions. A Nikon Labophot-2 microscope equipped with a drawing tube was used and all measurements and drawings are made in 2% KOH if not otherwise stated.

The holotypes of new species are deposited in the herbarium of the Institute of Zoology and Botany (TAA) or in mycological herbarium, Botanical Museum, University of Copenhagen (C).

LIST OF SPECIES

DERMATEACEAE

Belonopsis eriophori Raitv. species nova Figs. 1-4.
Apothecia superficilia, subiculata, substipitata, cupulata, 0.3-0.8 mm in diametro, extus fusco-nigra, disco griseo vel flavido-griseo, margine brunneo, in solutione KOH flavescentia. Excipulum ectale ex cellulis globosis crassiter fuscotunicatis 6-15 μm in diametro compositur. Medulla ex textura intricata, crystallorum minutarum plena. Asci uncinati, cylindraceo-clavati, octospori, 70-90 x 7-10 μm, poro iodo non caerulescentia Sporae irreglariter biseriatae, cylindraceae vel fusoideae, minute inequilateraliae, hyalinae, primo aseptatae dein uniseptate, minute biguttulatae, 16-19 x 3-3.5 μm. Paraphyses filiformes,1.5-2 μm in diametro, apicibus clavatis usque ad 4 μm in diametro. Belonopsidi hydrophilae similis, sed ascis et sporis majoribus et ascis inamyloideis differt.
Ad folia sicca Eriophori angustifolii crescit.

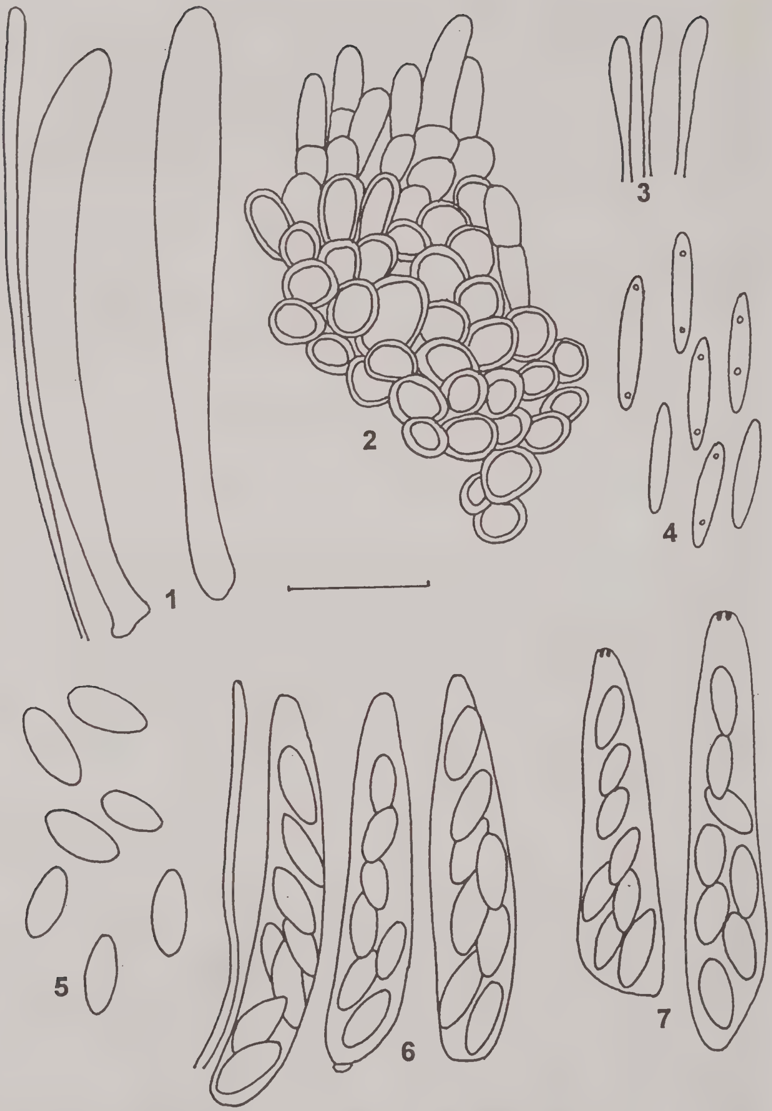
Apothecia scattered, superficial, substipitate on a small circular dark brown subiculum, exuding a yellow hue when mounted in KOH. Disc concave, 0.3-0.8 mm in diameter, greyish to pale yellowish-greyish. Receptacle cup-shaped, externally smooth, dark brown to blackish brown with brown margin. Ectal excipulum of brown to dark brown textura globulosa, cells thick-walled, 6-15 μm in diameter. Medulla of hyaline textura intricata filled with abundant small crystals of calcium oxalate. Asci arising from croziers, cylindric-clavate to cylindric, 8-spored, 70-90 x 7-10 μm, apical pore not blue in IKI or MLZ. Ascospores cylindric to fusoid, often slightly inequilateral, hyaline, at first aseptate, becoming uniseptate at maturity, containing two small polar lipid guttules, 16-19 x 3-3.5 μm. Paraphyses cylindric, apically clavate and up to 4 μm wide, hyaline.
On dead leaves of *Eriophorum angustifolium*.

Specimen examined: Greenland, Sisimiut, area in the main valley E of Sisimiut N of the mountain Alanngorsuaq, 66°54'N 53°37'W, on dead leaves of *Eriophorum angustifolium*, 18.08.2000, coll. A. Raitviir (TAA-137826, Holotype).
Notes: This species is similar to *Belonopsis hydrophila* (P. Karst) Nannf., differing from it in larger, iodine negative asci and in larger and more symmetrical, not clavate, spores.

Diplonaevia latispora Raitv. species nova Figs. 5-7.
Apothecia subepidermoidea, erumpentia, cupulata, 0.1-0.2 mm in diametro, extus brunnea, disco pallide ochraceo.. Excipulum ectale ex textura prismatica-angularis compositur, cellulis pallide brunneis, tenuiter tunicatis. Asci non uncinati, saccati, octospori, 50-60 x 8.5-11 μm, poro iodo caerulescentia praediti. Sporae irregulariter biseriatae, ellipsoideo-fusoideae, hyalinae, primo aseptatae dein uniseptatae, non guttulatae, 9.5-13.5 x 4-5 μm. Paraphyses cylindraceae, rectae, 1-1.5 μm in diametro.
Species ab aliis generis sporis latis symmetricis differt.
Ad folia sicca graminorum crescit.

Apothecia scattered, subepidermal, exposed through small gradually widening holes, 0.1-0.2 mm in diameter, externally dark brown, hymenium pale ochraceous. Excipulum of textura prismatica-angularis, cells with pale brown, thin walls. The cells at the inner side of apothecial margin ~~are~~ more or less flask-shaped, hyaline and refractive. Asci arising from simple septa, saccate, 8-spored, 50-60 x 8.5-11 μm, apical pore deeply blue in IKI and MLZ. Spores ellipsoid-fusoid, hyaline, aseptate, without inclusions, 9.5-13.5 x 4-5 μm. Paraphyses cylindrical, straight, apically not swollen, 1-1.5 μm wide.
On dead leaves of a small grass.
Specimen examined: Greenland, Sisimiut, area in the main valley E of Sisimiut N of the mountain Alanngorsuaq, 66°54'N 53°37'W, on dead leaves of a small grass, 18.08.2000, coll. A. Raitviir (TAA-137852, Holotype).
Notes: *Diplonaevia latispora* is well characterized by its comparatively short and wide. symmetrical spores. Slightly similar is *D. paulula* (Rob. ex Desm.) Scheuer but its spores are distinctly clavate and longer, 12-16.5 x 4-5.6 μm (Scheuer, 1991). The apothecial anatomy closely resembles that of *D. perpusilla* (Rehm) Hein and *D. salassorum* (Defago) Hein growing also on grasses but these species have completely different spores (Hein, 1983).

Leptotrochila axillaris (Rostr.) Raitv. comb. nov. Figs. 8-10.
Basionymum: *Pseudopeziza axillaris* Rostr., Meddr. Grønland 3: 612, 1891.
Apothecia arising on brownish spots on host leaves, erumpent, finally superficial, broadly sessile. Disc 0.5-1 mm in diameter, plane with distinct margin, blackish when dry. Receptacle saucer-shaped to discoid, black, smooth. Ectal excipulum of textura globulosa, cells with medium brown thin walls, 8-14 μm in diameter, marginal cells shortly clavate, paler brown to subhyaline. Asci



Figs. 1-4. ***Belonopsis eriophori.*** 1. A paraphysis and two asci. 2 Ectal excipulum. 3. Tips of paraphyses. 4. Spores. All from holotype. **Figs 5-7.** ***Diplonaevia latispora.*** 5. Spores. 6. A paraphysis and three asci in KOH. 7. Two asci in MLZ. All from holotype. Bar = 20 µm.

arising from croziers, cylindrical, 8-spored, 70-85 x 6-8 μm, apical pore deeply blue in MLZ. Spores ellipsoid to clavate ellipsoid, hyaline, aseptate, usually with two big lipid guttules, 8-12 x 3-4 μm. Paraphyses cylindrical, apically not swollen, containing numerous refractive bodies, not exceeding the asci, 2-2.3 μm in diameter.
On dead leaves of *Saxifraga axillaris*.
Specimen examined: Greenland, Kangatsiaq, 68°18'N 53°28' W, on dead leaves of *Saxifraga stellaris*, 12.07.1890, coll. N. Hartz (Holotype in C).
Notes: This species has remained unnoticed by all subsequent authors, is not listed in Saccardo's Sylloge Fungorum (Reed & Farr, 1993) and was overlooked by Schüepp (1959), but it is a good species of *Leptotrochila* which differs from *Leptotrochila svalbardensis* (Lind) Spooner & Nauta growing also on *Saxifraga* in shorter, biguttulate, aseptate spores and longer, comparatively more slender asci.

Sarconiptera Raitv. genus novum
Apothecia erumpentia, dein substipitata, cupulata, usque ad 2 mm in diametro, carnosa, vinacea. Excipulum ectale ex cellulis globosis pallide brunneis vel subhyalinis tenuiter tunicatis compositur. Medulla ex hyphis hyalinis subparallelis hyalinis compositur. Asci magni, non uncinati, clavati usque ad cylindraceo-clavati, octospori, poro iodo caerulescentia praediti Sporae irregulariter biseriatae, ellipsoideo-clavatae, hyalinae, aseptatae, rariter uniseptate, multiguttulatae vel non guttulatae. Paraphyses cylindraceae, rectae, 1-2 μm in diametro, apicibus minute subclavatis.
Genus Dermateacearum Nipterae Fr. simile sed in apotheciis magnis carnosis et colore vinaceo differt.
Typus generis: Sarconiptera vinacea Raitv.

Apothecia erumpent, becoming superficial and substipitate in early stages of development, often with a white hyphal mat around the base, up to 2 mm in diameter, fleshy, vinaceous. Ectal excipulum thick, of pale brown to subhyaline textura globulosa, cells thin-walled. Medulla of thin-walled, hyaline, more or less parallel hyphae. Asci large, clavate to cylindric, 8-spored, with a wide apical pore blue in MLZ. Ascospores ellipsoid, hyaline, aseptate or rarely uniseptate. Paraphyses cylindric, apically slightly clavate, hyaline. On dead grasses.
Type species: *Sarconiptera vinacea* Raitv.
Notes: A peculiar grass-inhabiting dermateaceous fungus from Greenland, described below, cannot be satisfactorily accommodated in any known genus of the Dermateaceae. Its characteristic features are fairly large fleshy apothecia with predominantly reddish colours.

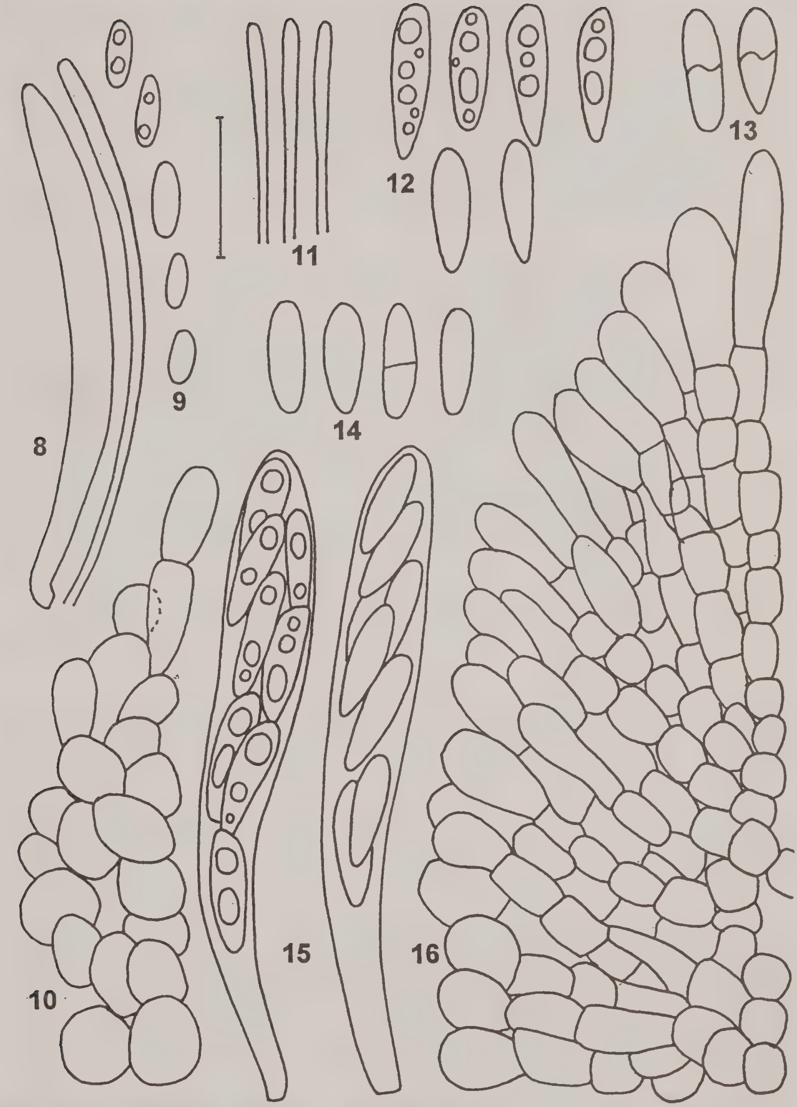
Sarconiptera vinacea Raitv. species nova Figs. 11-16.
Apothecia erumpentia, dein substipitata, cupulata, 1-2 mm in diametro, disco vinaceo vel subroseo, extus brunneo-vinacea vel pallide roseo-brunnea.

Excipulum ectale ex cellulis globosis pallide brunneis vel subhyalinis tenuiter tunicatis 5-10μm in diametro compositur. Medulla ex hyphis hyalinis subparallelis hyalinis compositur. Asci non uncinati, clavati usque ad cylindraceo-clavati, octospori, 80-125 x 8-13 μm, poro iodo caerulescentia praediti Sporae irreglariter biseriatae, ellipsoideo-clavatae, hyalinae, aseptatae, rariter uniseptate, multiguttulatae vel non guttulatae, 14-19 x 4-6 μm. Paraphyses cylindraceae, rectae,1-2 μm in diametro, apicibus minute subclavatis.
Species unica generis.
Ad folia sicca graminorum crescit.

Apothecia solitary, erumpent, becoming superficial and substipitate in early stages of development, often with a white hyphal mat around the base. Disc concave to shallow concave,1-2 mm in diameter, vinaceous to pinkish, surrounded by a brownish margin. Receptacle cup-shaped to shallow cup-shaped, fleshy, externally smooth, brownish-vinaceous to light pinkish brown. Ectal excipulum thick, of pale brown to subhyaline textura globulosa, cells thin-walled, 5-10 μm in diameter. Medulla of thin-walled, hyaline, more or less parallel hyphae. Asci arising from simple septa, clavate to cylindric-clavate, rarely cylindric, 8-spored, 80-125 x 8-13 μm, with a wide apical pore blue in MLZ. Ascospores ellipsoid-clavate, inequilateral, hyaline, aseptate or rarely becoming uniseptate at maturity, containing several big lipid guttules or sometimes without inclusions, 14-19 x 4-6 μm. Paraphyses cylindric, apically slightly clavate, hyaline.
On dead culms of grasses.
Specimens examined: Greenland, Sisimiut, area between Sisimiut and the coastal mountain chain Nasaasaaq, 66°55'N, 53°39'W, on dead culms of *Festuca vivipara* (L.) Sm., 17.08.2000, A. Raitviir, (holotype TAA-137803); Paamiut, 62 00'N 49 41'W, on a small grass, 16.09.1979, coll T. Borgen (paratype C-TB.155.79).
Notes: In the field this striking species resembles in its fairly large, wine-coloured to pinkish brown apothecia a member of an operculate genus *Pseudombrophila* Boud. Microscopically, however, it has mollisioid structure and inoperculate asci placing it into the Dermateaceae. In this family it does not match well any described genus being probably most close to *Niptera* Fr., differing from it in much thicker, fleshy excipulum and pink to vinaceous colours in hymenium and receptacle. For this reason a new genus *Sarconiptera* is described for it.

HYALOSCYPHACEAE

Amicodisca groenlandica Raitv. species nova Figs. 17-20.
Apothecia superficilia, late sessilia, ad usque 0.75 mm in diametro, hymenio pallide viride-olivaceo, extus olivaceo-virida, dense luteo-viridipilosa. Excipulum ectale ex textura prismatica compositur. Pili cylindraceo-conici,



Figs. 8-10. ***Leptotrochila axillaris.*** 8. Ascus and paraphysis. 9. Spores. 10. Ectal excipulum. All from holotype. **Figs. 11-16.** ***Sarconiptera vinacea.*** 11. Tips of paraphyses. 12. Spores from holotype. 13. Spores in MLZ, left from holotype, right from paratype. 14. Spores from paratype. 15. Two asci, left from holotype, right from paratype. 16. Ectal excipulum from holotype. Bar = 20 µm.

aseptati, tenuiter tunicati, subhyalini, obscure pallide citrinei vel pallide olivacei, 80-120 x 3-3.5 μm, apicibus 1-1.2 μm diametro. Asci non uncinati, cylindraceo-clavati, octospori, (85-)92-116 x 12-15 μm, poro iodo caerulescentia praediti. Sporae ellipsoideae vel ellipsoideo-clavatae, saepe suballantoideae, 1-3-septatae, 2-4- vel multiguttulatae, 20-27 x 3-5 μm. Paraphyses cylindraceae, ascos non superantes, 0.8 μm latis.
In cortice putrido Betulae crescit.
Amicodiscae virellae (P. Karst.) Huhtinen similis, sed in sporis et ascis majoribus differt.

Apothecia superficial, scattered to gregarious, broadly sessile. Disc up to 0.75 mm diam., pale greenish-olivaceous when fresh, dark green when dry. Receptacle cup-shaped to saucer-shaped, externally olivaceous-green when fresh, dark green when dry, densely covered with yellowish-green hairs looking phosphorescent when fresh. Ectal excipulum of textura prismatica to textura angularis, cells thin-walled, pale olivaceous, 6-8 x 3-4 μm. Hairs cylindric-conical, aseptate, straight, hyaline, dull lemon yellow to pale olivaceous, thin-walled, smooth, bearing numerous loosely attached small, olivaceous-greenish granules dissolving in KOH and yielding a lemon-yellow hue, 80-120 x 3-3.5 μm, apically tapering to 1-1.2 μm. Asci arising from simple septa, cylindric-clavate, 8-spored, (85-)92-116 x 12-15 μm, with a wide apical pore faintly blue in MLZ. Spores ellipsoid to clavate-ellipsoid, hyaline, often slightly curved to suballantoid containing 2 or 4 big lipid globules, sometimes multiguttulate, becoming 1-3-septate 20-27 x 3-5 μm. Paraphyses cylindrical, not exceeding the asci, 0.8 μm wide.
On the inner side of rotten *Betula pubescens* bark.
Specimen examined: Greenland, Qinqua valley at Taserssuaq Lake, 60°16'N, 44°33'W, on the inner side of rotten *Betula pubescens* bark, 27/7-1/8.1984, coll. H. Knudsen, (Holotype HK&TL-84.239 in C).
Notes: This species is macroscopically very similar to the other known species of *Amicodisca*. Microscopically it is distinct having much larger asci and spores than *A. virella* (P. Karst.) Huhtinen.

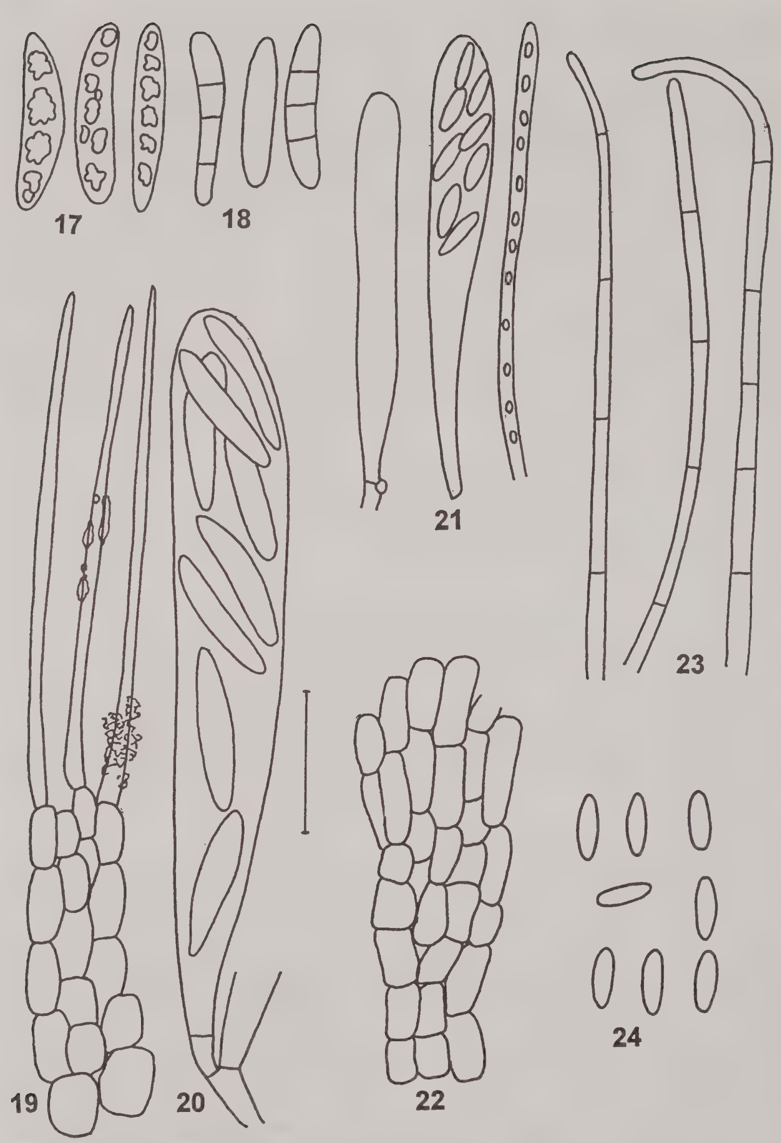
Arachnopeziza groenlandica Raitv. species nova Figs. 21-24.
Apothecia superficilia, anguste vel late sessilia in subiculo albo restricto vel nullo, 0.2-0.6 mm in diametro, hymenio flavido, extus albida, dense longe albopilosa, in solutione KOH flavescentia. Excipulum ectale ex textura prismatica compositur, cellulis hyalinis tenuiter tunicatis. Pili cylindracei, multiseptati, tenuiter tunicati, hyalini, 60-90 x 2.5-3.5 μm. Asci uncinati, cylindracei vel cylindraceo-clavati, octospori, 55-65 x 6-8 μm, poro iodo non caerulescentia. Sporae hyalinae, ellipsoideae, aseptatae, non guttulatae, 7-11 x 2.5-3.5 μm. Paraphyses cylindraceae, ascos non superantes, 1.5-2.5 μm in diametro.
Arachnopezizae leoninae (Schw.) Dennis similis, sed in pilis hyalinis et sporis minoribus differt.

Ad lignum putridum crescit.

Apothecia superficial, scattered, sessile on a narrow base to broadly sessile, developing on a scanty, whitish subiculum restricted to the apothecial base or almost lacking, exuding a pale yellow hue when mounted in KOH. Disc 0.2-0.6 mm diam, yellowish, shallow concave to plane. Receptacle cupulate to shallow cupulate, pure white, covered with long white hairs. Ectal excipulum thin and delicate, of textura prismatica, cells hyaline, thin-walled, 7-14 x 4-6 μm. Hairs cylindrical, slightly tapering toward a rounded apex, hyaline, multiseptate, straight to slightly flexuous, apically sometimes slightly curved, thin-walled, smooth, fragile, 60-90 x 2.5-3.5 μm. Asci arising from croziers, cylindrical to cylindric-clavate, 8-spored, 55-65 x 6-8 μm, apical pore clearly visible in CR+phase contrast, not blue in IKI or MLZ. Spores uniseriate or biseriate, ellipsoid, hyaline, aseptate, without inclusions, 7-11 x 2.5-3.5 μm. Paraphyses cylindrical, apically not swollen, sometimes containing yellow droplets, 1.5-2.5 μm wide.
On small dead branches of *Salix glauca*.
Specimen examined: Greenland, Sisimiut, area in the main valley E of Sisimiut N of the mountain Alanngorsuaq, 66°54'N 53°37'W, on dead branches of *Salix glauca*, 18.08.2000, coll. H. Knudsen & M. Sasa (holotype TAA-137864, isotype in C).
Notes: *A. groenlandica* has an inamyloid ascus pore in contrast to all known species of *Arachnopeziza* and it is also characterized by a yellow pigment in the paraphyses that dissolves in KOH. This arctic species bears some similarity to two *Arachnopeziza* species, viz. *A. leonina* and *A. trabinelloides*. From the first one it differs in completely hyaline hairs lacking any orange pigment and in smaller aseptate spores. From the second one it differs in smooth, not granulate hairs, in unbranched, aseptate paraphyses with simple apices, and in smaller aseptate spores.

Calycina ovalipilosa Raitv. species nova Figs. 25-27.
Apothecia superficilia, subsessilia vel sessilia, 0.2-0.3 mm in diametro, hymenio griseo-albido usque ad pallide ochraceo, extus concoloria, ad marginem albopubescentia. Excipulum ectale ex textura prismatica compositur, cellulis hyalinis tenuiter tunicatis. Pili ellipsoidei vel ellipsoideo-fusoidei, aseptati vel uniseptati, tenuiter tunicati, 8-25 x 5-8.5 μm. Asci uncinati, cylindraceo-clavati, octospori, 50-65 x 5-7 μm, poro iodo caerulescentia praediti. Sporae hyalinae, ellipsoideae, aseptatae, raro leniter uniseptatae, multiguttulatae, 10-12 x 2-3 μm. Paraphyses cylindraceae, ascos non superantes.
Calycinae herbarum similis, sed in ascis et sporis minoribus et in pilis majoribus differt.
Ad lignum putridum crescit.

Apothecia superficial, solitary to scattered or gregarious, sessile on a narrow base to subsessile. Disc 0.2-0.3 mm diam., shallow concave, plane or slightly



Figs. 17-19. ***Amicodisca groenlandica.*** 17. Three spores in KOH. 18. Three spores in MLZ. 19. Ectal excipulum with hairs. 20. Ascus. All from holotype. **Figs. 21-24.** ***Arachnopeziza groenlandica.*** 21. Two asci and paraphysis. 22. Ectal excipulum. 23. Hairs. 24. Spores. All from holotype. Bar = 20 μm.

convex, greyish-whitish to pale ochraceous. Receptacle cupulate to deeply cupulate, concolorous with the hymenium or slightly darker at the base, with whitish, pubescent margin. Ectal excipulum of textura prismatica, individual cells thin-walled, hyaline, variable in size, 8-20 x 4-8 μm, more elongated at the flanks, shorter at the base. Marginal hairs ellipsoid to ellipsoid-fusoid, mostly apically pointed, 0-1-septate, 8-25 x 5-8.5 μm, hyaline, thin-walled, smooth, without contents. Hairs on the flanks similar to marginal hairs but slightly shorter, up to 20 μm long. Asci arising from croziers, cylindric-clavate, 8-spored, 50-65 x 5-7 μm, apical pore deep blue in IKI and in MLZ. Spores irregularly biseriate, ellipsoid, straight, hyaline, aseptate, rarely becoming uniseptate, with several irregular lipid guttules, 10-12 x 2-3 μm. Paraphyses cylindrical, narrow, up to 1 μm wide.

On decaying wood of *Salix glauca*.

Specimens examined: Greenland, Kangerlussuaq, surroundings of lake Helen, 66°59'N 50°59'W, on a dead branch of *Salix glauca*, 14.08.2000, coll. A. Raitviir (TAA-137786, holotype).

Notes: This lignicolous *Calycina* can be easily recognized by its pale, almost sessile apothecia and characteristic ellipsoid-fusoid hairs. It can be compared with *Calycina herbarum* Pers., but the latter is herbicolous, has much bigger apothecia, asci and spores, and its excipulum is composed of small short cells. *Cystopezizella fallax* Svrček (1992) is also similar in ellipsoid-fusoid marginal hairs but differs in narrow, only 2-3 μm wide, thick-walled excipular cells, excipulum staining violaceous-gray in MLZ, and smaller spores, measuring 6-11 x 1.5-2 μm.

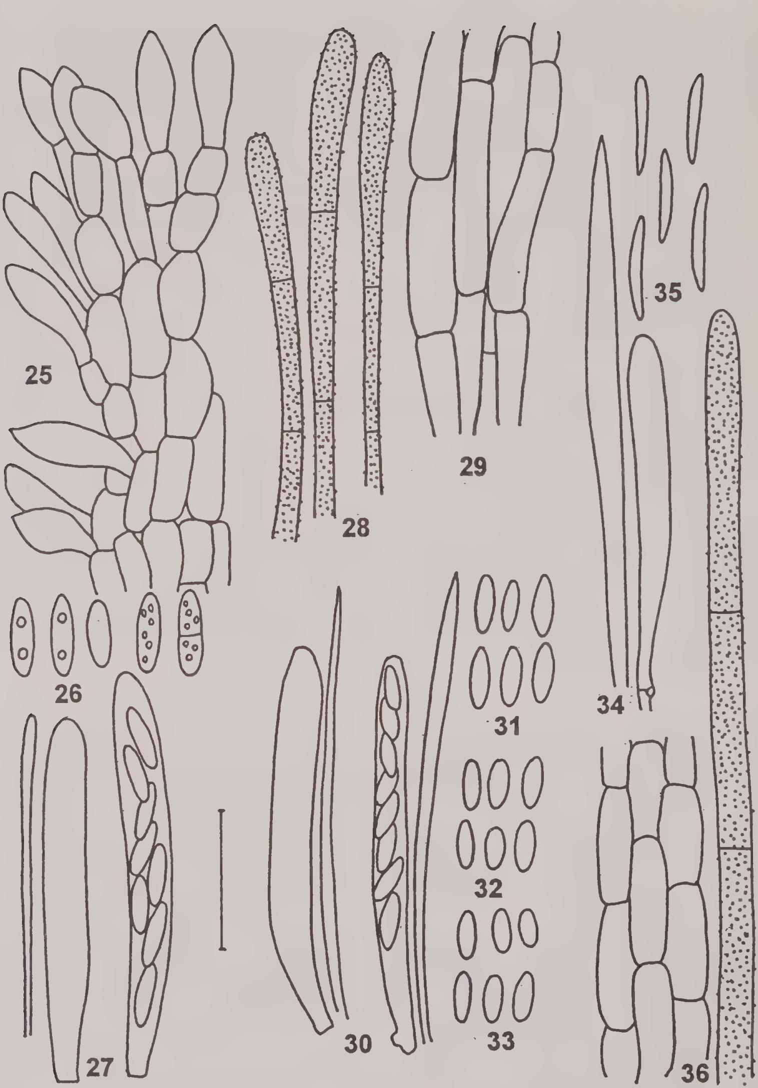
Lachnum arcticum Raitv. species nova Figs. 28-33.

Apothecia sparsa usque ad gregaria, stipitata, cupulata, 0.5-3 mm diametro, disco niveo, receptaculo albido, sicca pallide cremeo, dense longipiloso. Excipulum ectale ex textura prismatica compositur, cellulis elongatibus hyalinis, tenuiter tunicatis, 14-33 x 3-6 μm. Pili cylindracei, apicibus leniter dilatatis, 1-3-septati, tenuiter hyalinotunicati, verruculati, 50-80 x 3-4 μm. Asci uncinati, cylindraceo-clavati, octospori, 55-65 x 5.5-6.5 μm, poro iodo caerulecentia praediti. Sporae uniseriatae vel irregulariter biseriatae, hyalinae, late fusoideae vel ovato-fusoideae, rectae, aseptatae, non guttulatae, rariter minute biguttulatae, 6-9 x 2.5-3.5 μm. Paraphyses lanceolatae, ascos 6-12 μm superantes, 2-3 μm in diametro.

Species unica lignicola sporis late fusoideis vel ovato-fusoideis et apotheciis non erubescentis distincta.

Ad lignum putridum crescit.

Apothecia scattered to gregarious, stipitate. Disc 0.5-3 mm in diameter, pure white when fresh, remaining white when dry. Receptacle deeply cupulate to cupulate, white when fresh, pale cream-coloured when dry, covered, particularly at the margin, with white straight hairs. Stipe cylindrical, long, slender, equalling in length ~~to~~ the diameter of disc, white. Ectal excipulum of



Figs. 25-27. ***Calycina ovalipilosa.*** 25. Ectal excipulum with hairs. 26. Spores. 27. A paraphysis and two asci. **Figs. 28-33.** ***Lachnum arcticum.*** 28. Three hairs from TAA-137888. 29. Ectal excipulum from TAA-137829. 30. Two asci with paraphyses (Left from TAA-137888, right from TAA-137868). 31. Spores from TAA-137829. 32. Spores from TAA-137868. 33. Spores from TAA-137888. **Figs. 34-36.** ***Lachnum uliginosum.*** 34. A paraphysis and ascus. 35. Spores. 36. Ectal excipulum and hair. All from holotype. Bar = 20 μm.

hyaline textura prismatica, cells comparatively narrow and elongated, 14-33 x 3-6 μm. Hairs cylindrical, gradually slightly widening toward apex, hyaline, thin-walled, finely warted all over, 50-80 x 3-4 μm, 1-3-septate, not bearing crystals. Asci arising from croziers, cylindric-clavate, 8-spored, 55-65 x 5.5-6.5 μm, apical pore blue in MLZ. Spores broadly fusoid to ovate-fusoid, hyaline, aseptate, eguttulate or sometimes with two small polar guttules, 6-9 x 2.5-3.5 μm. Paraphyses lanceolate, aseptate, not containing guttules, exceeding the asci by 6-12 μm, 2-3 μm wide.

Specimens examined: Greenland, Sisimiut, area between Sisimiut and the airport, 66°57'N 53°44'W, on dead branches of *Salix glauca*, 19.08.2000, coll. A. Raitviir (TAA-137888, holotype, isotype in C). Sisimiut, area in the main valley E of Sisimiut N of the mountain Alanngorsuaq, 66°54'N 53°37'W, on dead branches of *Salix glauca*, 18.08.2000, coll. A. Raitviir (TAA-137829, 137857, 137868).

Notes: This species is somewhat similar to *Lachnum impudicum* Baral but differs clearly in wider spores. There is no other *Lachnum* species with such broadly fusoid to ovate-fusoid spores.

Lachnum uliginosum Raitv. species nova Figs. 34-36.

Apothecia sparsa usque ad gregaria, stipitata, cupulata, 0.5-1.5 mm diametro, disco niveo, receptaculo albido, immutabili, dense longipiloso. Excipulum ectale ex textura prismatica compositur, cellulis hyalinis tenuiter tunicatis. Pili cylindracei, apicibus rotundatis, 1-4-septati, tenuiter hyalinotunicati, verruculati, 80-120 x 4-5 μm. Asci uncinati, cylindraceo-clavati, octospori, 50-60 x 5-6 μm, poro iodo caerulescentia praediti. Sporae irregulariter biseriatae, hyalinae, fusoideae, rectae vel minute curvatae, aseptatae, non guttulatae, 10-15 x 1.5-1.8 μm. Paraphyses lanceolatae, ascos 20-30 μm superantes, 3.5-5 μm in diametro.

Species vacciniophila pilis latis et sporis longis minute curvatis distincta.

Ad ramum siccum Vaccini uliginosi crescit.

Apothecia scattered or in small groups, stipitate. Disc 0.5-1.5 mm in diameter, pure white when fresh, remaining white when dry. Receptacle deeply cupulate to cupulate, white when fresh and dry, covered, particularly at the margin, with long white straight hairs. Stipe cylindrical, long, slender, equalling in length ~~to~~ the diameter of disc, concolorous with the receptacle. Ectal excipulum of hyaline, thin-walled prismatic cells. Hairs cylindrical, apically rounded, hyaline, thin-walled, finely warted all over, 80-120 x 4-5 μm, 1-4-septate, not bearing crystals. Asci arising from croziers, cylindric-clavate, 8-spored, 50-60 x 5-6 μm, apical pore blue in MLZ. Spores fusoid, sometimes slightly inequilateral to curved, hyaline, aseptate, eguttulate, 10-15 x 1.5-1.8 μm. Paraphyses lanceolate, aseptate, not containing guttules, exceeding the asci by 20-30 μm, 3.5-5 μm wide.

Specimen examined: Greenland, Nuuk, 64°10' N 51°45' W, on a dead twig of *Vaccinium uliginosum* (host determined by Alar Läänelaid (Tartu), 5-6.08. 1987, coll. H. Knudsen (holotype in C).
Notes: This species is well characterized by comparatively wide, evenly cylindrical hairs and narrowly fusoid spores of medium length. There is a very small number of so called typical *Lachnum* species having spores in the length class 10-15 μm, all of them growing on monocotyledonous plants, including *L. diminutum* (Rob.) Rehm on *Juncus*, *L. elongatisporum* Baral and *L. pudicelloides* Raitv. on grasses, differing from *L. uliginosum* in several characters. *L. uliginosum* seems to be a *Vaccinium* specific, or, probably, an Ericaceae specific species which should be looked for in arctic and alpine areas. *L. virgineum* (Batsch) P. Karst., the most common white *Lachnum.* is also quite often found growing on dead branches of Ericales but it is clearly different in shorter spores and differently shaped, apically more or less capitate, hairs.

Mollisina groenlandica Raitv. species nova Figs. 37-42.
Apothecia sparsa vel gregaria, substipita, 0.2-0.5 mm in diametro, cupulata vel patelliformes, extus albida, minute puberula, disco albido vel pallide cremea.. Excipulum extale ex cellulis prismaticis hyalinis compositur. Pili cylindracei vel subclavati, apicibus ramosis, 10-20 x 2-3.5 μm. Asci non uncinati, cylindraceo-clavati vel clavati, octospori, poro iodo non coerulescentia, 40-52 x 5-6.5 μm. Sporae fusoideae, hyalinae, aseptatae, biguttulatae, dein 1-septatae, 10-12 x 2.4-3 μm. Paraphyses filiformes, ascos non superantes, 1.5-2 μm, apicibus clavatis usque ad 3.5 μm in diametro.
Ad caulem siccum Epilobii latifolii crescit.
Mollisinae minutissimae Raitv. & Galán similis, sed sporis majoribus fusoideis biguttulatis differt.

Apothecia scattered to gregarious, substipitate. Disc 0.2-0.5 mm in diameter, whitish to cream-coloured when fresh and dry. Receptacle shallow cup-shaped to saucer-shaped, pure white, minutely glittering downy. Ectal excipulum of a few layers of hyaline, thin-walled to firm-walled, elongated prismatic cells at the flanks and margin; cell walls with irregular cyanophilic thickenings and bearing short, solid projections. Marginal hairs conical, thin-walled, hyaline, 10-20 x 2-3.5 μm. Hairs at the flanks irregular, up to 15 μm long, bearing numerous finger-shaped branches at their upper ends; branches up to 4 μm long, solid when intact but losing solidity in KOH. Asci arising from simple septa, cylindric-clavate to clavate, 8-spored, 40-52 x 5-6.5 μm, apical pore not blue in MLZ. Spores fusoid, hyaline, at first aseptate, containing two big lipid globules, later becoming 1-septate, 10-12 x 2.4-3 μm. Paraphyses filiform, apically swollen up to 3.5 μm, not exceeding the asci, 1.5–2 μm wide in lower part.
Specimen examined: Greenland, Sisimiut, area between Sisimiut and airport, on a dead stem of *Epilobium latifolium*, 66°57' N 53°44' E, 19.08.2000, coll. H. Knudsen & M. Sasa (holotype TAA-137897a).

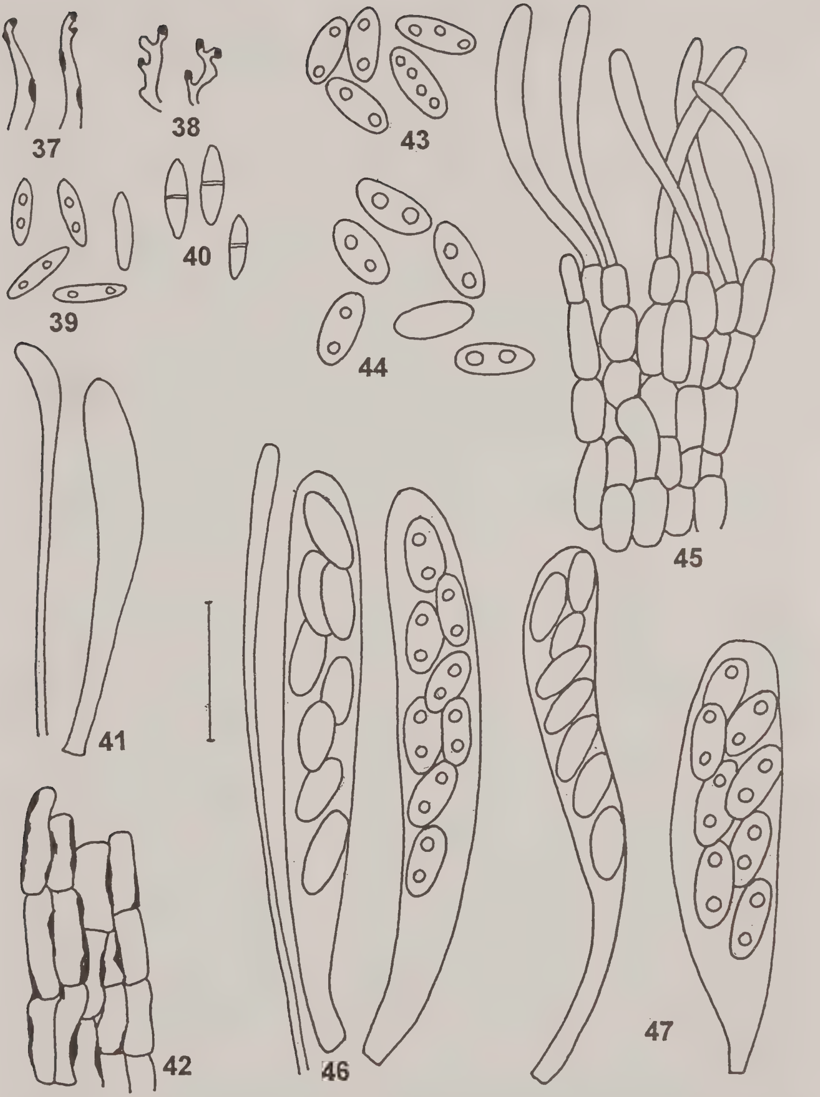
Notes: *Mollisina groenlandica* is similar to *M. minutissima* growing on *Cistus ladanifer* branches in Spain, the only known species of *Mollisina* with permanently inamyloid asci. *M. groenlandica* differs from the latter in distinctly larger (10-12 x 2.4-3 μm versus 6-7.5 x 2-2.7 μm) fusoid, biguttulate spores.

Psilocistella alchemillae Raitv. species nova Figs. 43-47.
Apothecia superficilia, solitaria, sparsa vel gregaria, subsessilia vel sessilia, 0.2-0.5 mm in diametro, applanato-cupulata vel patelliformia, hymenio griseo-albido usque ad pallide ochraceo, extus concoloria, ad marginem albopubescentia. Excipulum ectale ex textura prismatica vel textura angularis compositur, cellulis hyalinis tenuiter tunicatis. Pili ad marginem cylindracei, aseptati vel uniseptati, tenuiter tunicati, laeves, 25-50 x 3-3.5 μm. Pili laterales cylindraceo-clavati, hyalini, apicibus fuscoincrustatis, 10-20 x 3-4 μm. Asci non uncinati, cylindraceo-clavati vel clavati, octospori, 60-80 x 9-13.5 μm, poro iodo non caerulescentia. Sporae hyalinae, ellipsoideae, aseptatae, biguttulatae, 9.5-12 x 4-4.5 μm. Paraphyses cylindraceae, apicibus minute clavatis, 2.5-3 μm latis, ascos non superantes.
Psilocistellae macrosporae Raitv. similis, sed in ascis minoribus non caerulescentibus differt.
Ad caules et folia sicca Alchemillae glomerulans crescit.

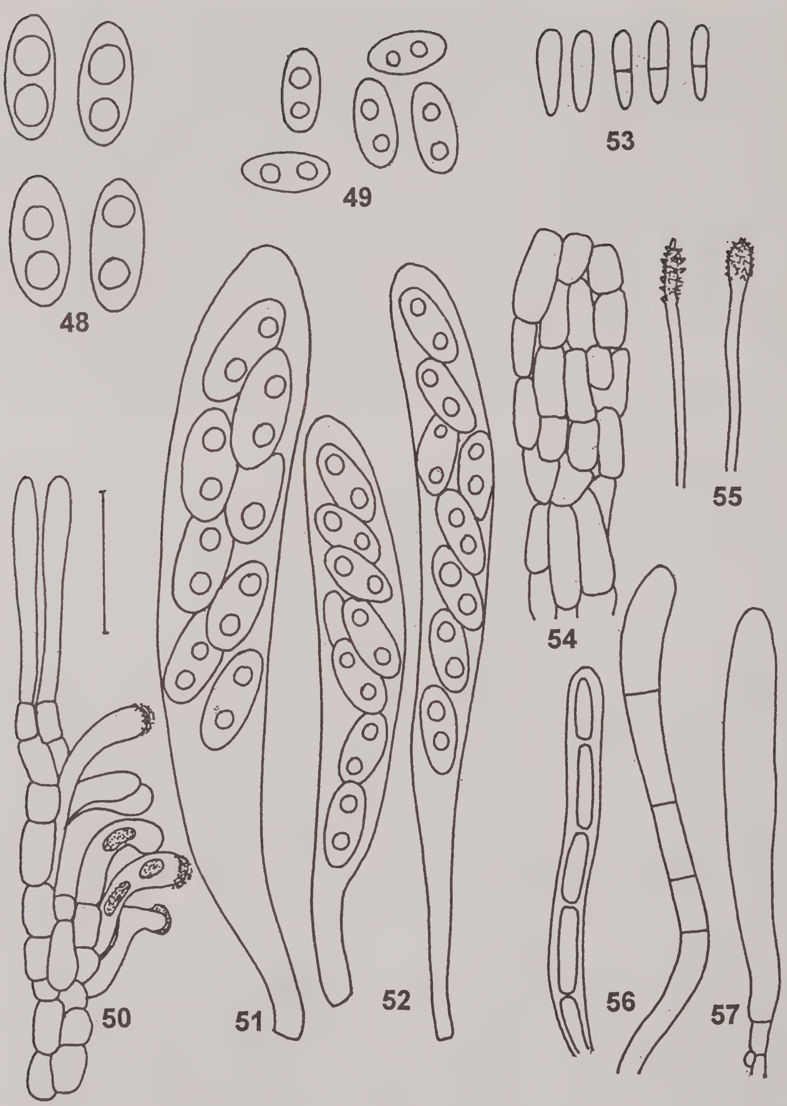
Apothecia superficial, solitary, scattered or gregarious, sessile on a narrow base to subsessile. Disc 0.2-0.5 mm diam., shallow concave, plane or slightly convex, greyish-whitish to pale ochraceous or pale brownish. Receptacle shallow cupulate to saucer-shaped, concolorous with the hymenium but darker at the base, with whitish, pubescent margin. Ectal excipulum of textura prismatica to textura angularis, individual cells thin-walled, hyaline, 5-14 x 3-6 μm at the flanks, more rounded, 7-10 x 6-10 μm at the base. Marginal hairs cylindrical, apically rounded, 0-1-septate, 25-50 x 3-3.5 μm, hyaline, thin-walled, smooth, sometimes with pale yellowish-brownish content in apical cell. Hairs on the flanks cylindric-clavate, hyaline, sometimes apically with hyaline amorphous encrustation, 10-20 x 3-4 μm. Asci arising from simple septa, cylindric-clavate to clavate, 8-spored, 60-80 x 9-13.5 μm, apical pore not blue in IKI or MLZ. Spores irregularly uni- or biseriate, ellipsoid, straight, hyaline, aseptate at maturity, with two big lipid globules, 9.5-12 x 4-4.5 μm. Paraphyses cylindrical, apically slightly clavate, hyaline, not exceeding the asci, 2.5-3 μm wide.
On dead stems and leaves of *Alchemilla glomerulans.*
Specimens examined: Greenland, Sisimiut, area in the main valley E of Sisimiut N of the mountain Alanngorsuaq, 66°54'N 53°37'W, on dead stems and leaves of *Alchemilla glomerulans*, 18.08.2000, coll. H. Knudsen & M. Sasa (TAA-137837, holotype, isotype in C); coll A. Raitviir (TAA-137834).
Notes: *Psilocistella alchemillae* is similar to *P. macrospora* Raitv. but differs from it in smaller asci with an IKI and MLZ negative pore. *P. alchemillae* has also smaller spores than *P. macrospora.*

Psilocistella macrospora Raitv. species nova Figs. 48-52.
Apothecia superficilia, solitaria, sparsa vel gregaria, subsessilia vel sessilia, 0.2-0.5 mm in diametro, applanato-cupulata vel patelliformia, hymenio griseo-albido usque ad pallide ochraceo vel pallide brunnea, extus concoloria, ad marginem albopubescentia. Excipulum ectale ex textura prismatica vel textura angularis compositur, cellulis hyalinis usque ad pallide brunneis tenuiter tunicatis. Pili ad marginem cylindracei, aseptati vel uniseptati, tenuiter tunicati, laeves, 25-33 x 3.5-5 μm. Pili laterales cylindraceo-clavati, hyalini, apicibus fuscoincrustatis, 10-22 x 3-5 μm. Asci non uncinati, cylindraceo-clavati vel clavati, octospori, 80-125 x 10-13 μm, poro iodo caerulescentia praediti. Sporae hyalinae, ellipsoideae, aseptatae, dein usque ad uniseptatae, biguttulatae, 10-15 x 5-6.5 μm. Paraphyses cylindraceae, apicibus minute clavatis, 3-4 μm latis, ascos non superantes.
Species unica generis in ascis magnis clavatis distincta.
Ad caules et folia sicca herbarum crescit.

Apothecia superficial, solitary, scattered or gregarious, sometimes confluent, sessile to subsessile on a narrow base. Disc 0.2-0.5 mm diam., shallow concave, plane or slightly convex, greyish-whitish to pale ochraceous or pale brownish. Receptacle shallow cupulate to discoid, concolorous with the hymenium, with whitish, pubescent margin. Ectal excipulum of textura prismatica to textura angularis, individual cells thin-walled, hyaline, 8-12 x 4-7 μm at the flanks, hyaline to pale brownish and more rounded, 10-14 x 7-10 μm at the base. Marginal hairs cylindrical, apically rounded, 0-1-septate, 25-33 x 3.5-5 μm, hyaline, thin-walled, smooth, sometimes with pale yellowish-brownish content in the apical cell. Lateral hairs cylindric-clavate to clavate, often apically curved, with yellowish-brownish content and sometimes apically with yellowish-brownish amorphous encrustation, 10-22 x 3-5 μm. Asci arising from simple septa, cylindric-clavate to clavate, 8-spored, 80-125 x 10-13 μm, apical pore wide and very short, deep blue in IKI or MLZ. Spores uni- or biseriate, ellipsoid, straight, hyaline, tardily 1-septate at maturity, with two big lipid globules, 10-15 x 5-6.5 μm. Paraphyses cylindrical, apically slightly clavate, with hyaline or pale brownish content, not exceeding the asci, 3-4 μm wide.
On dead stems and leaves of *Epilobium latifolium* and *Alchemilla alpina*.
Specimens examined: Greenland, Sisimiut, area in the main valley E of Sisimiut N of the mountain Alanngorsuaq, 66°54'N 53°37'W, on dead stems and leaves of *Epilobium latifolium*, 18.08.2000, coll. A. Raitviir (TAA-137842, holotype, isotype in C; TAA-137833); Sisimiut, area in the main valley E of Sisimiut N of the mountain Alanngorsuaq, 66°54'N 53°37'W, on dead stems and leaves of *Alchemilla alpina*, 18.08.2000, coll. H. Knudsen & M. Sasa (TAA-137866).
Notes: This species is surely a member of the genus *Psilocistella* having typical apothecial anatomy, hairs and inclusions (vacuolar bodies sensu Baral) in hairs and paraphyses. It is, however, unique in its huge asci. *P. macrospora* is a



Figs. 37-42. ***Mollisina groenlandica***. 37. Marginal hairs. 38. Hairs from the flanks. 39. Spores. 40. Spores in MLZ. 41. Paraphysis and ascus. 42. Ectal excipulum. All from holotype. **Figs. 43-47.** ***Psilocistella alchemillae.*** 43. Spores from TAA-137837. 44. Spores from TAA-137834. 45. Ectal excipulum with hairs from TAA-137837. 46 Paraphysis and asci from TAA-137834. 47. Asci from TAA-137837. Bar = 20 μm.



Figs.48-52. ***Psilocistella macrospora.*** 48. Spores from TAA-137836. 49. Spores from TAA-137842. 50. Ectal excipulum with hairs from TAA-137842. 51. Asci from TAA-137836. 52. Ascus from TAA-137842. **Figs. 53-57.** ***Solenopezia groenlandica.*** 53. Spores. 54. Ectal excipulum. 55. Paraphyses. 56. Hairs. 57. Ascus. All from holotype. Bar = 20 μm.

polyphagous species growing on *Epilobium latifolium* and *Alchemilla alpina*. It is somewhat surprising that another *Alchemilla* species, *A. glomerulans*, has a different species of *Psilocistella*.

Solenopezia groenlandica Raitv. species nova Figs. 53-57.
Apothecia superficilia, sessilia, 0.2-0.5 mm in diametro, urceolata, extus nigrofusca, densiter fuscopilosa, albomarginato collariata, hymenio griseolo. Pili cylindracei, flexuosi, apicibus rotundatis, multicellulares, crassiter tunicati, pallide brunnei, fuscogranulati, apicibus hyalinis, 80-120 x 2.5-3.5 μm. Pili marginales cylindracei, recti vel subflexuosi, tenuiter vel subcrassiter tunicati, 50-80 x 2.5-3.5 μm, intra collum cylindracei vel subconici, hyalini, tenuiter vel crassiter tunicati, 3-5-septati, usque ad 75 x 2-3.5 μm. Asci uncinati, cylindraceo-clavati, apicibus conicis, octospori, 50-65 x 7-9 μm, poro iodo caerulescentia praediti. Sporae irregulariter biseriatae, clavatae usque ad cylindraceo-fusoideae, hyalinae, multiguttulatae, uniseptatae, 10-13 x 2-3.5 μm. Paraphyses cylindraceae, 1.2-2 μm in diametro, apicibus clavatis, 3-4 μm latis, crystallis minutis hyalinis incrustatae.
Solenopeziae leucostomae similis, sed in pilis brevioribus, sporis latioribus et paraphysis clavatis incrustatis differt.
Ad lignum putridum crescit.

Apothecia superficial, scattered to gregarious, sessile, deeply cupulate to urceolate. Disc 0.2-0.5 mm in diameter, greyish. Receptacle urceolate, blackish brown, covered with blackish brown hairs, when fresh with a raised and dry collar lined at the margin with a white fringe. Ectal excipulum of textura angularis at the base, cells medium brown, thick-walled, 6-8 μm in diameter, and textura prismatica at the flanks and margin, cells pale brownish, 8-13 x 4.5-6 μm. Medullary excipulum of hyaline, dense textura intricata. Excipular hairs abundant on flanks of apothecium, 80-120 x 2.5-3.5 μm, cylindrical with obtusely rounded tips, flexuous, multiseptate, cells in apical part usually shorter than cells in central and basal part,. thick-walled, walls smooth, pale brownish but hyaline in the uppermost cell, covered with fine dark brown to blackish, more or less loosely attached granules. Marginal hairs up to 50-80 x 2.5-3.5 μm, cylindrical, straight to slightly flexuous, thin-walled to moderately thick-walled, multiseptate, pigmented like the hairs on the flanks. Hairs on the inner side of collar up to 75 x 2-3.5 μm, thin- to thick-walled, 3-5 septate, hyaline, cylindrical to subconical Asci arising from croziers, but at maturity often with a secondary simple septum slightly higher of crozier, cylindric-clavate with conical apex, 8-spored, 50-65 x 7-9 μm, apical pore visible in untreated preparations, deep blue in MLZ. Ascospores irregularly biseriate, 10-13 x 2-3.5 μm, clavate to cylindric-fusoid, straight, containing numerous small lipid guttules, regularly uniseptate, usually septate while still in the ascus, hyaline. Paraphyses 1.2-2.0 μm wide, apically clavate, 3-4 μm wide, encrusted with small hyaline crystals, not or slightly exceeding the asci.
On dead wood.

Specimen examined: Greenland, Sisimiut, area between Sisimiut and the airport, on dead wood of *Salix glauca*, 66°57'N 53°44'W, 19.08.2000, coll. H. Knudsen & M. Sasa (TAA-137893, holotype, isotype in C).
Notes: *Solenopezia groenlandica* differs from all known species of *Solenopezia* in pigment not changing colour in KOH. It bears some similarity to *S. leucostoma* (Rehm) Raitv., J. H. Haines & E. Müll. but differs from it in much shorter hairs on the flanks of apothecium, wider clavate spores and clavate incrusted paraphyses. *S. groenlandica* is the first species of *Solenopezia* growing on dead wood; all other species grow on dead herbaceous stems.

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TRICHIA PAPILLATA, A NEW COPROPHILOUS MYXOMYCETE SPECIES

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ABSTRACT

A new species, *Trichia papillata,* is described on the basis of collections from Lithuania. It is characterised by angular peridial plates with a central papilla, double-crested spirals on the elaters, and yellow spore mass. *T. papillata* was obtained from moist chamber cultures of hare (*Lepus* sp.) and roe deer (*Capreolus capreolus*) dung collected in the southern Lithuania. The species is illustrated with SEM photographs and compared with other stalked yellow-spored *Trichia* species with areolate peridia.

Key words: myxomycetes, taxonomy, Lithuania

INTRODUCTION

Among various substrata for myxomycetes, herbivore dung which contains high levels of organic substances and has high pH values is one of the most special ones. It harbours a fairly large number of species, a certain number of which being recorded only from this particular type of substrate thus suggesting a highly specialized coprophilous myxomycete biota. Eliasson & Keller (1999) list 99 myxomycete species and varieties from this substratum including 15 taxa so far collected exclusively from dung. Mitchell (2000) presents a list of 100 taxa with minor changes, adding the recently described coprophilous *Perichaena taimyrensis* Novozh. & Schnittler (Novozhilov & Schnittler, 2000).

Running of moist chambers of hare (*Lepus* sp.) dung collected in the south-eastern Lithuania resulted in obtaining a stalked yellow-spored *Trichia* species with strikingly regular polygonal peridial plates with a papilla in the centre and double-crested spirals on the elaters. The specimens sharing these characteristics were later obtained again in two moist chambers of roe deer (*Capreolus capreolus*) dung collected in the southern Lithuania. The specimens differ from all described *Trichia* species in a set of traits, therefore are described here as representing a new species.

MATERIAL AND METHODS

The new *Trichia* species was obtained from moist chamber cultures of hare and roe deer dung. The cultures were prepared following Härkönen (1977). Attempts of spore-to-spore cultivation on half-strength corn meal agar with addition of 0.5 ml 1% *Saccharomyces cerevisiae* suspension failed. Description of the species was made from fresh preparations in 3% KOH. Scanning electron micrographs were made from air-fresh material with Hitachi S2500 at the Natural History Museum, London. Colours are given according "Methuen Handbook of Colour" (Kornerup & Wanscher, 1978). Authorities are cited according to Kirk & Ansell (1992). Compendium of morphological characteristics of stalked yellow-spored *Trichia* species with reticulated peridium was compiled based on Martin & Alexopoulos (1969), Nannenga-Bremekamp (1991), Neubert, Nowotny & Baumann (1995), Yamamoto (1998), Ing (1999), Mitchell (2000).

TAXONOMY

Trichia papillata Adamonyte **sp. nov.** Fig. 1, A–G

Sporangia congregata sunt turmis de paucis, stipitata, 1.2–1.5 mm altitudinis. Sporotheca globosa, (310–)535(–700) µm diam., obscure brunnea cum reticulis flavis. Peridium duplex, adpressum, dehiscens in segmenta angularia habentia in centro papilas. Tubuli capillitii cum apicibus brevibus, ornati 3–4 spiris cum duplici vertice interdum cum extremitate verruculosa. Sporae habent minutas et densas verrucas, 9–10.3 µm diam. Plasmodium flavum.

Holotypus *collectus de excrementis leporis lectis 17.7.2001 ad locum Puvočiai prope Merkinė in Lithuania, 54°07′ N 24°19′ E, in herbario Instituti Botanici Lithuaniae (BILAS) sub numero 23671 depositus. Isotypi in LE (220336), GU (s. n.) et herbario privato Mitchell (6752) depositi. Legit G. Adamonytė.*

Sporocarps formed in small groups, stalked, (1.2–)1.4(–1.5) mm high. Sporotheca globose, well defined from the stalk, (310–)535(–700) µm diam., dark reddish-brown (7F8) with a network of yellow bands. Hypothallus inconspicuous, membranous, blackish-brown (6H8). Stalk cylindrical, erect, (0.5–)0.75(–1.0) mm high, (70–)147(–197) µm diam., black, opaque; sometimes with 2–3 stalks merging together. Peridium double, in the upper part of sporotheca dehiscing along bands in angular patches and remaining as a small cup at the base; outer layer thick, including granular refuse material, maize yellow (4A6) by transmitted light; inner layer membranous, translucent, pale yellow (3A3) to white yellow (3A2), its inner side covered with an arched pattern of warts and warted striae. A fold in the centre of every peridial segment forms a papilla. Elaters golden yellow (4C6) to amber yellow (4B6) by transmitted light, long, with 1–3 short pointed ends (6.5–20 µm), sometimes with small expansions below the tip, rarely with short side-branches up to 15 µm long, (3.2–)4.5–5 µm diam incl. ornamentation, decorated with 3–4 spirals with a double crest, which is partly covered with scattered warts, and appearing rough and fringed under a light-microscope. Spores brazen yellow (4C7) in mass, wheat yellow (4B5) to chamois (4C5) by transmitted light, minutely warted (oil-immersion), 9–10.3 µm diam., with an inconspicuous germination area. Plasmodium egg-yellow.

Etymology: in reference to folds – "papillae" in the centre of peridial segments.

Distribution: known from moist chamber cultures of dung collected in Prienai and Varėna distrs., Lithuania.

Other material examined. Paratypes: BILAS 23672 on roe deer dung, 54°30′ N 23°47′ E, Lithuania, Prienai distr., Ąžuolų Nature Reserve, 27 June, 2002; BILAS

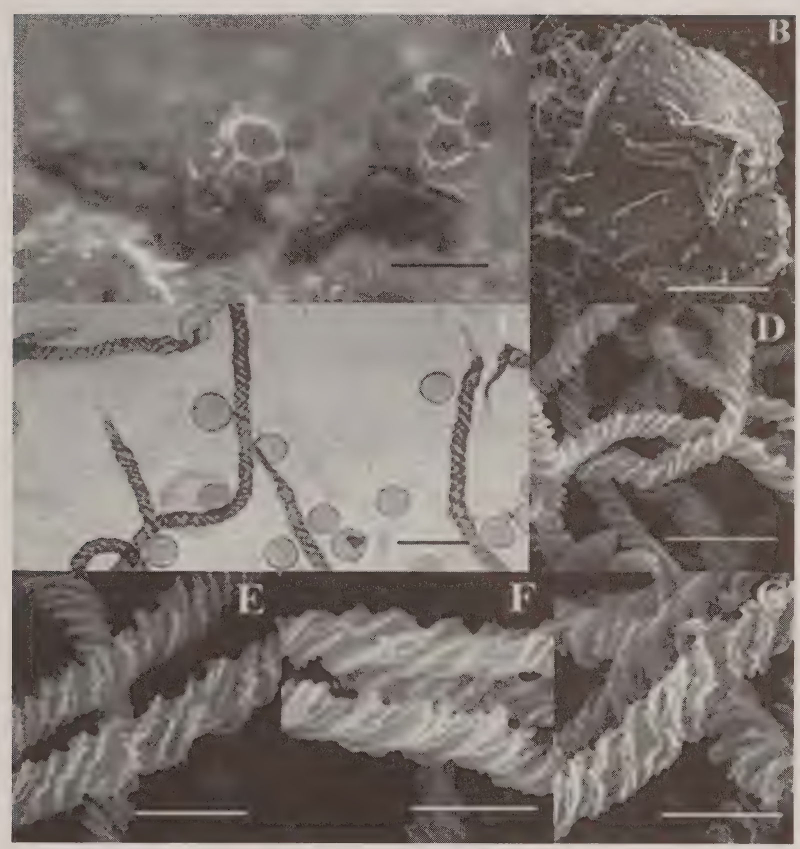

Fig. 1. *Trichia papillata* sp. nov.: A – sporocarps (holotype, bar = 0.5 mm), B – a segment of peridium (paratype, BILAS 23672; bar = 100 μm), C – elater tips (holotype, bar = 20 μm), D–G – ornamentation of elaters (D–F – holotype, G – paratype, BILAS 23672; bars: D = 12 μm, E–G = 6 μm).

23932 on roe deer dung, Lithuania, Prienai distr., Gojaus forest, 54°34' N, 24°16' E, 27 September, 2002. *Trichia erecta*: No. 2496 (type), bark of old spruce logs, Adirondack Mts. N. Y. Dr. Geo. A. Rex; NY Bot. Gard. Myxomycetes No. 4963, Smoky Mts. Park, Sevier Co, Tenn. 18.08.1939; s. n. Sweden, Bohuslän, Göteborg, Backa, 20 Sept. 1972, leg. M. Neuendorf.

Comments. Sporocarps of the type developed on hare (*Lepus* sp.) dung collected on 17 July, 2001 in Varėna distr. Moist chamber was established on 23 July, its pH after soaking was 6.25. Sporocarps first emerged on 15 October. In total, more than 110 sporocarps developed during 70–80 days of cultivation. The second collection of the species was obtained from roe deer (*Capreolus capreolus*) excrement collected in Prienai distr. on 27 June, 2002. Moist chamber culture was set on 4 July, 2002, sporocarps first emerged on 3 September, at the same time a yellow plasmodium was noted. As no other species developed in the chamber and no sclerotium was observed, it was accepted that it belonged to the new species. During 60–77 days a total of more than 120 sporocarps developed. The third collection of *T. papillata* was obtained also from roe deer dung, collected in Prienai distr. on 27 September, 2002. Culture was set on 19 December, 2002 and more than 60 mature myxomycete sporocarps were noticed on 4 April, 2003.

So far, four stalked *Trichia* species with distinct yellow bands on the sporotheca have been described: *T. botrytis* (J. F. Gmel.) Pers., *T. erecta* Rex, *T. flavicoma* (Lister) Ing, and *T. munda* (Lister) Meyl. *Trichia papillata* is distinguished macroscopically from all other *Trichia* species with areolate peridia by its papillate peridium which is divided by narrow yellow bands into angular segments (Table 1). Also, this is the only species of the group with yellow plasmodium.

Table 1. Summary on stalked species with areolate peridium

	***Trichia papillata* n. sp.**	***Trichia botrytis***	***Trichia erecta***	***Trichia flavicoma***	***Trichia munda***
Sporocarp height	1.2–1.5 mm	1–4 mm	1–3 mm	up to 1 mm	0.3–1.5 mm
Peridium colour	dark brown	red-brown to purple-brown or almost black	red or purple-brown to black	pale brown to black	yellow-brown to dark brown, grey or purple
Dehiscense	by a few angular lobes	by numerous irregular lobes	by a few irregular lobes	by numerous irregular lobes	by a few irregular lobes
Peridial papillae	present	absent	absent	absent	absent
Elaters	short-tipped, spirals double-crested	long-tipped, smooth	short-tipped, smooth or with scattered spines	long-tipped, smooth	long-tipped, smooth
Spore mass	brazen yellow	yellow-brown to dull ochraceous	bright yellow	golden-yellow fading to ochraceous	red-brown
Spores	minutely warted, 9–10.3 μm diam.	minutely warted, 9–13 μm diam.	conspicuously warted, showing border in optical section, 11–15 μm diam.	densely minutely warted, 11–14 μm diam.	minutely spinulose showing border in optical section, 9–13 μm diam.
Plasmodium	egg-yellow	purple-brown to black	white	white	white

Additionally, the new species differs from *T. botrytis, T. flavicoma,* and *T. munda*, all of which have smooth elaters with long ends, in having short-tipped intricately decorated elaters. It differs from *T. erecta,* which also has short-tipped elaters, in having smaller faintly warted spores (11–15 µm vs. 9–10.3 µm) and coarser capillitium ornamentation. Examination of the type material of *T. erecta* and other collections of this species showed that the upper part of the peridium was divided by yellow bands into irregular small patches, their spore mass was bright yellow, elaters in slides with KOH tended to coil around themselves and changed their colour to orange, spirals were rounded and covered with short spines which spread more or less densely. Rounded elaters with short scattered spines of the type material of *T. erecta* are shown in SEM photographs by Rammeloo (1986). Meanwhile, elaters of *T. papillata* do not change their colour in KOH and remain deep yellow, their crests appear sharp and rough under the compound microscope.

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ARACHNOSPORA INSOLITA, A NEW GENUS AND SPECIES, AND SOME OTHER HYPHOMYCETES FROM BANAO, SANCTI SPIRITUS PROVINCE, CUBA

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ABSTRACT

Arachnospora insolita anam. gen. et sp. nov. found on rotten leaves of an unidentified plant in Banao, Cuba is described and illustrated. It is distinguished by solitary, spider-shaped, brown conidia, which are detached by rhexolytic conidial secession. Twenty-five other hyphomycetes collected in the same locality are recorded.

Key words: Systematics, tropical fungi, leaf litter

INTRODUCTION

Numerous microfungi were collected during a mycological survey of saprobe conidial fungi in several undisturbed rainforests in Banao, Sancti Spiritus province, Cuba. An undescribed fungus was among the specimens collected, and it is described herein as *Arachnospora insolita* anam. gen. sp. nov.

MATERIALS AND METHODS

Leaf litter samples were placed in separate paper bags and taken to the laboratory. Single conidia were removed from the substrate immediately after it was collected. Conidia were transferred to on corn meal/carrot extract agar (1:1), and incubated at 25 °C under alternating cycles of 12 hours of daylight and darkness. Other samples were incubated in Petri dish moist chambers at 25 °C and examined at regular intervals for the presence of microfungi. Mounts were prepared in DL-lactic acid 85 % and polyvinyl alcohol-glycerol (8.0 g in 100 ml of water, plus 5 ml of glycerol) and measurements made at 1000-x magnification.

TAXONOMIC PART

Arachnospora anam. gen. nov. R. F. Castañeda, Minter et Camino anam. gen. nov.
Etymology: Latin, *arachnoideus*- formed of delicate hairs; -spora, referred to the conidia.
Ad fungos conidiales, hyphomycetes pertinens. ***Coloniae*** *funiculosae, effusae, brunneae vel atrobrunneae.* ***Mycelium*** *superficiale, ex hyphis septatis, ramosis, longissimis, laevibus vel verruculosis, brunneis vel atrobrunneis compositum.* ***Conidiophora*** *macronemata, eramosa, cylindricae, erecta vel laxa usque ad prostrata, septata, levia vel verruculosa, brunnea vel atrobrunnea.* ***Cellulae conidiogenae*** *hologenosae, uniloculosae, terminales, in conidiophoris incorporatae*; *brunneae, determinatae vel indeterminata, cum proliferationibus percurrentis enteroblastica praeditae.* ***Loco conidiogeno*** *apicale.* ***Secedentia conidiorum*** *rhexolytica.* ***Conidia*** *holoblastica, solitaria, acrogena, levia vel verruculosa, tortuosa, plus minusve turbinata vel irregularia ex 2-5-cellulis conformata et 4-8-ramis primarias cornutas, di- vel trichotomis, mutatis ad apicem appendicibus cellularis, valde incurvatis composita.*
Teleomorphosis ignota.
Species typica: *Arachnospora insolita* anam. sp. nov.

Conidial fungi, hyphomycetes. **Colonies** funiculose, effuse, brown or dark brown. **Mycelium** superficial, composed of septate, branched and elongated, smooth or verruculose, brown or dark brown hyphae. **Conidiophores** macronematous, unbranched cylindrical, erect, loose or prostrate, septate, smooth or verruculose, brown to dark brown. **Conidiogenous cells** hologenous, unilocal, terminal, integrated, brown, determinate or indeterminate with several enteroblastic percurrent proliferations. **Conidiogenous loci** apical. **Conidial secession** rhexolytic. **Conidia** holoblastic, solitary, acrogenous, smooth or verruculose, complex, more or less turbinate or irregular, formed by 2-5 cells and 4-8 horn-shaped primary branches which are di- or trichotomous, strongly incurved towards the apex and terminating in cellular appendages.
Teleomorph unknown.

Type species: *Arachnospora insolita* anam. sp. nov.

Arachnospora superficially resembles *Arachnophora* Hennebert (1963), (Castañeda Ruiz *et al.* 1997; Castañeda Ruiz and Guarro, 1998), but the latter has conidia composed of one or two central cells from which arise several radial arms sometimes curved, as in *Arachnophora fagicola* Hennebert (1963). Conidial secession in *Arachnophora* is rhexolytic and a conspicuous frill derived from the upper part of the conidiogenous cell remains attached to the conidia. In *Arachnospora* the conidia detach by rhexolytic secession, but rarely does an evident frill remain, and branches only develop towards the apex. The genus *Iyengarina* Subram. (Ellis, 1971) is rather similar to *Arachnospora*, but the type species, *Iyengarina elegans* Subram. (Ellis, 1971), has y-shaped conidia with two divergent arms and conidial secession is apparently rhexolytic.
Some described species of *Acrodictys* M. B. Ellis (1961, 1971, 1976), recently studied by Whitton *et al.* (2000), also have conidia with cellular appendages, but in fact the conidia are typically muriform and cannot be confused with the proposed genus

Arachnospora. Conidia of other described genera such as *Actinocladium* Ehrenb (Ellis, 1971) and *Tetraploa* Berk. & Broome (Ellis 1971) are somewhat branched or have several ornamented, septate arms, but these genera are quite different from *Arachnospora*. *Actinocladium* has conidia with 1-4 transverse septa in the main body or stalk; the terminal swollen cell is unequally divided by an oblique septum, the larger cell becomes transversely septate and produces one of the arms. The other arms develop as lateral swellings from the smaller cell according to Ellis (1971). In *Tetraploa* the conidiophores are undifferentiated and the conidia are muriform formed by 3 or 4 columns of cells, which develop independently and terminate each in a septate cellular appendage; these features are different from those *Arachnospora.*

Arachnospora insolita R. F. Castañeda, Minter et Camino anam. sp. nov. (Figs. 1-3)
Etymol. Latin: *insolita*, meaning rare or uncommon.
***Coloniae** in substrato naturali funiculosae, effusae, hypophyllae, brunneae vel atrobrunneae. **Mycelium** superficiale, ex hyphis septatis, ramosis, longissimis, laevibus, brunneis vel atrobrunneis, 4-7 μm diam., compositum. **Conidiophora** macronemata, eramosa, cylindricae, erecta vel laxa usque ad prostrata, 1-4-septata, levia, brunnea vel atrobrunnea, 35-80 x 8-12 μm. **Cellulae conidiogenae** hologenosae, uniloculosae, terminales, in conidiophoris incorporatae; brunneae, determinatae vel indeterminata, cum 1-3-proliferationibus percurrentis enteroblastica praeditae. **Loco conidiogeno** apicale. **Secedentia conidiorum** rhexolytica. **Conidia** holoblastica, solitaria, acrogena, levia, tortuosa, plus minusve turbinata vel irregularia, in summa 60-70 x 35-40 μm, ex 2-5-cellulis conformata ad corporis principalis; cellulis basalibus cylindricis, truncatis infra, 12-15 x 5-9 μm dilute brunneis usque ad subhyalinis, interdum collapsis; cellula secunda et tertiaria sub-conica, 6-10 x 9-12 μm, dilute brunnea usque ad brunnea et quaternia vel quinaria cellulis longioris 14-19 x 19-25 μm, atrobrunnea usque nigra et 4-6(-8)-ramis cornutas. Ramis di- or trichotomis, cornuatis, filiformis or cylindricis, septatis, brunneis infra, dilute brunneis ad usque apicem, vel alternatim brunneis and pallide brunneis pigmentosis, valde incurvatis, laevibus, 15-40 x 2-3 μm, 1.0-1.5 μm crassa ad apicem.*
Teleomorphosis ignota.
Matrix: In foliis dejectis non determinatis, in sylva pluvialis, Caja de Agua, Banao, Leg. D. Minter and M. Camino, 11. XII. 2001.
Holotypus. MUCL 42859.
Isotypus: INIFAT C01/83-3, Santiago de Las Vegas, Ciudad de La Habana, Cuba.

Colonies on natural substrate funiculose, effuse, hypophyllous, brown to dark brown. **Mycelium** superficial, composed of septate, branched, long, smooth-walled, brown to dark brown, 4-7 μm diam. hyphae. **Conidiophores** macronematous, unbranched, cylindrical, erect, loose or prostrate, 1-4-septate, smooth-walled, brown to dark brown, 35-80 x 8-12 μm. **Conidiogenous cells** hologenous, unilocal, terminal, integrated, brown, determinate or indeterminate with 1-3 enteroblastic percurrent proliferations. **Conidiogenous loci** apical. **Conidial secession** rhexolytic. **Conidia** holoblastic, solitary, acrogenous, smooth-walled, complex, turbinate or irregular, in all 60-70 x 35-40 μm, composed of 2-5-cells in the stalk; with cylindrical, truncate 12-15 x 5-9 μm, pale brown to subhyaline, sometimes collapsed basal cell; second and third cells sub-conical, 6-10 x 9-12 μm, pale brown to brown; fourth or fifth cell longer, 14-19 x 19-25 μm, dark brown or black, and 4-6(-8)- horned branches. Branches di- or trichotomous, horned, filiform or cylindrical, septate, brown below, pale brown towards the apex or alternately pigmented brown and pale brown, strongly curved inwards, 15-40 x 2-3 µm, 1.0-1.5 µm wide at the apex.

Teleomorph unknown.

Matrix: On decaying leaves of unidentified plant, in a rainforest, Caja de Agua, Banao, coll. D. Minter and M. Camino, 11. XII. 2001.

Holotype. MUCL 42859.

Isotype: INIFAT C01/83-3, Santiago de Las Vegas, Ciudad de La Habana, Cuba.

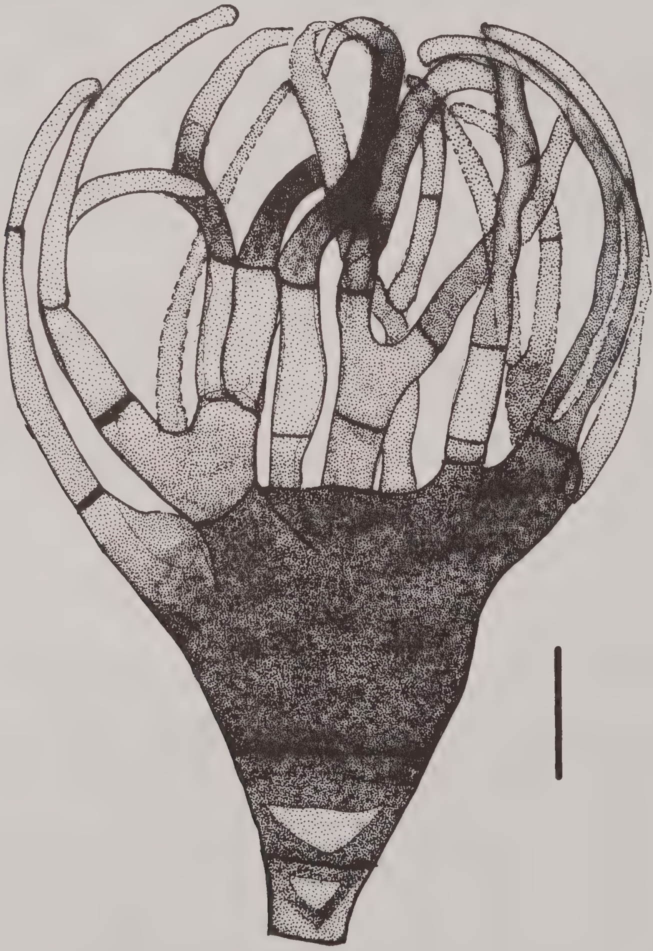

Fig.1. *Arachnospora insolita* (MUCL 42859). Conidium. Bar = 10 µm.

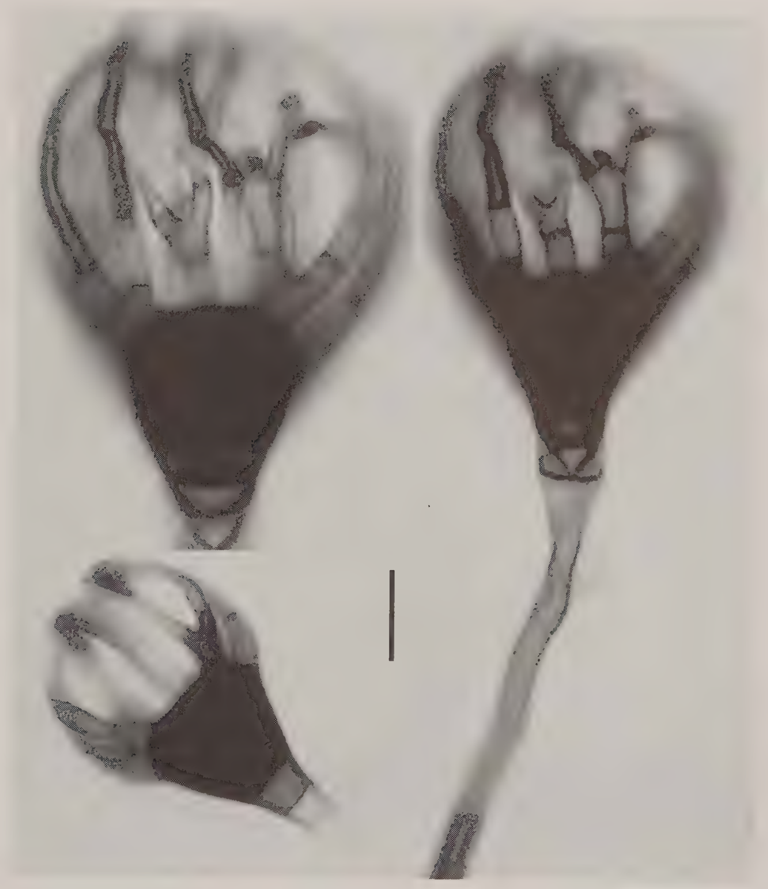

Fig. 2. *Arachnospora insolita* (MUCL 42859). Left. two conidia. Right. Conidiogenous cell and conidium. Bar = 10 µm.

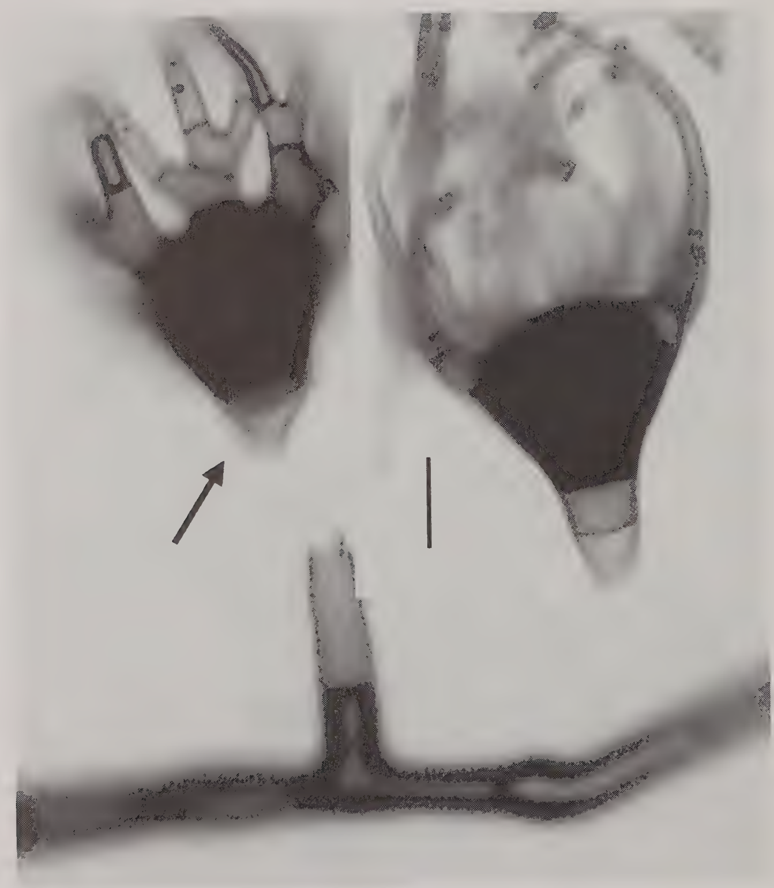

Fig. 3. *Arachnospora insolita* (MUCL 42859). Above. Two conidia, arrow: attachment point of conidium. Below. Conidiophore and conidiogenous cell. Bar = 10 µm.

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INIFAT C01/78, ex decaying twig, Caja de Agua, Banao, coll. D. Minter and M. Camino, 11. XII. 2001.

Bactrodesmium novageronensis R. F. Castañeda, *Inst. Inves. Fund. Agric. Trop.* **2** (1985).
INIFAT C01/84, ex rotten leaf, Caja de Agua, Banao, coll. D. Minter and M. Camino, 11. XII. 2001.

Beltrania rhombica Penz., *Nuovo G. Bot. Ital.* **14:** 72 (1882).
INIFAT C01/81-9, ex rotten leaf, Caja de Agua, Banao, coll. D. Minter and M. Camino, 11. XII. 2001.

Beltraniella havanensis (Hol.-Jech.) Matsush., *Matsushima Mycological Memoirs* **5:** 5, (1987)
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INIFAT C01/90-2, ex rotten leaf, Caja de Agua, Banao, coll. D. Minter and M. Camino, 11. XII. 2001.

Dactylaria fusiformis Shearer & J. L. Crane, *Mycologia* **63:** 243 (1971).
INIFAT C01/79-6, ex rotten leaf, Caja de Agua, Banao, coll. D. Minter and M. Camino, 11. XII. 2001.

Dactylaria sparsa R. F. Castañeda & W. B. Kendr., *University of Waterloo Biology Series*, **35:** 33 (1991).
INIFAT C01/81-6, ex rotten leaf, Caja de Agua, Banao, coll. D. Minter and M. Camino, 11. XII. 2001.

Dendryphion cubense Matsush., *Matsushima Mycological Memoirs* **5:** 11 (1987).
INIFAT C01/96, ex decaying leaves, Caja de Agua, Banao, coll. D. Minter and M. Camino, 11. XII. 2001.

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INIFAT C01/84-2, ex decaying leaves, Caja de Agua, Banao, coll. D. Minter and M. Camino, 11. XII. 2001.

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INIFAT C01/97, ex decaying leaves, Ladera Norte, Banao, coll. D. Minter and M. Camino, 11. XII. 2001.

Gyrothrix circinata (Berk. & Curt.) S. Hughes, *Can. J. Bot.* **36:** 771 (1958).
INIFAT C01/92-1, ex decaying leaves, Caja de Agua, Banao, coll. D. Minter and M. Camino, 11. XII. 2001.

Holubovaniella gracilis R. F. Castañeda *Deuteromycotina de Cuba. Hyphomycetes* **3**. *Inst. Inves. Fund. Agric. Trop.* 18 (1985).
INIFAT C01/90, ex decaying leaves, Caja de Agua, Banao, coll. D. Minter and M. Camino, 11. XII. 2001.

Idriella cubensis R. F. Castañeda & Arnold, *Rev. Jard. Bot. Nac.* **6:** 50 (1985).
INIFAT C01/93, ex decaying leaves, Caja de Agua, Banao, coll. D. Minter and M. Camino, 11. XII. 2001.

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Menisporopsis nova-zelandiae S. Hughes & W. B. Kendr., *N. Z. Jl. Bot.* **6:** 369 (1968).
INIFAT C01/76, ex decaying leaves, Caja de Agua, Banao, coll. D. Minter and M. Camino, 11. XII. 2001.

Menisporopsis theobromae S. Hughes, *Mycol. Pap.* **48:** 59 (1952).
INIFAT C01/79-4, ex decaying leaves, Caja de Agua, Banao, coll. D. Minter and M. Camino, 11. XII. 2001.

Nakataea fusispora Matsush., *Icones Microfungorum a Matsushima Lectorum*, Kobe, p. 100 (1975).
INIFAT C01/97-1, ex decaying leaves, Ladera Norte, Banao, coll. D. Minter and M. Camino, 11. XII. 2001.

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INIFAT C01/82-3, ex decaying leaves, Caja de Agua, Banao, coll. D. Minter and M. Camino, 11. XII. 2001.

Stachybotrys longispora Matsush., *Icones Microfungorum a Matsushima Lectorum*, Kobe, p. 145 (1975).
INIFAT C01/95-1, ex decaying leaves, Cortinas Blancas, Banao, coll. D. Minter and M. Camino, 11. XII. 2001.

Thozetella cristata Piroz. & Hodges, *Can. J. Bot.* **51:** 168 (1973).
INIFAT C01/90-1, ex decaying leaves, Caja de Agua, Banao, coll. D. Minter and M. Camino, 11. XII. 2001.

Thozetella cubensis R.F. Castañeda & G.R.W. Arnold, *Rev. Jard. Bot. Nac.* **6:** 51 (1985).
INIFAT C01/94, ex decaying leaves, Caja de Agua, Banao, coll. D. Minter and M. Camino, 11. XII. 2001.

Torula herbarum (Pers.) Link, *Magazin. Gesellschaft Naturforschender Freunde zu Berlin* **7:** 40 (1816).
INIFAT C01/89, ex rotten leaves, Cortinas Blancas, Banao, coll. D. Minter and M. Camino, 11. XII. 2001.

Wiesneriomyces laurinus (Tassi) P.M. Kirk, *Trans. Br. Mycol. Soc.* **82:** 748 (1984).
INIFAT C01/88, ex rotten leaves, Cortinas Blancas, Banao, coll. D. Minter and M. Camino, 11. XII. 2001.

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THE LICHEN GENUS PARAPARMELIA, A SYNONYM OF XANTHOPARMELIA (ASCOMYCOTA, PARMELIACEAE)

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ABSTRACT : The lichen genus *Paraparmelia* is reduced to synonymy under *Xanthoparmelia*. The key characters of *Xanthoparmelia* include the cell walls containing *Xanthoparmelia*-type lichenan, the pored epicortex, eciliate margins, simple rhizines, small, ellipsoidal spores and bifusiform or rarely weakly fusiform or bacilliform conidia. Five new names are proposed: *Xanthoparmelia aridella*, *X. colensoides*, *X. inconspicuella*, *X. rugulosella* and *X. xanthomelanella* and 77 new combinations are made.

KEY WORDS: *Xanthoparmeli aridella, Xanthoparmelia colensoides, Xanthoparmelia conspicuella, Xanthoparmelia rugulosella, Xanthoparmelia xanthomelanella*

Introduction

A detailed study of a range of recent and type collections of the parmelioid genera *Paraparmelia* Elix & J.Johnst. and *Xanthoparmelia* (Vain.) Hale and, in particular, the cortical chemistry of many species, has indicated that these genera are synonymous. This conclusion has been confirmed by recent molecular studies (Crespo *et al.* 2001; Hawksworth & Crespo 2002) utilizing mitochondrial DNA which suggested that *Paraparmelia* resides in the same monophyletic clade as *Xanthoparmelia, Chondropsis* Nyl. ex Crombie and *Neofuscelia* Essl. The original separation of these two genera was as much a consequence of history as a conscious taxonomic decision, since *Xanthoparmelia* was segregated from *Parmelia sens. lat.* (Hale 1974) whereas *Paraparmelia* was subsequently segregated from the heterogeneous genus *Pseudoparmelia* Lynge (Elix *et al.* 1986). Although the proximity of *Paraparmelia* to some species of *Xanthoparmelia* was recognised at that time (Elix *et al.* 1986), an appreciation of the variability of both the medullary and, more particularly, the cortical chemistry followed later (Elix 2001). In retrospect, the only consistent difference between the two groups of species was the colour of the upper surface (yellow-green in *Xanthoparmelia*, grey in *Paraparmelia*) which in turn reflected the chemistry of the upper cortex (usnic acid in *Xanthoparmelia*, atranorin ±chloroatranorin in

Paraparmelia). However, with improved methods of analysis (HPLC) it has become obvious that in some species there exists a continuum of variation in cortical chemistry - from usnic acid with no atranorin detected, to usnic acid (major), atranorin (minor) and then usnic acid (minor), atranorin (major). Such variations have been observed in the following species: *Xanthoparmelia elixii* Filson, *X. globulifera* (Kurok. & Filson) Hale, *X. metaclystoides* (Kurok. & Filson) Elix & J.Johnst., *X. neorimalis* (Elix & P.M.Armstr.) Elix & T.H.Nash, *X. nigraoleosa* Elix & J.Johnst., *X. parvoclystoides* Elix & J.Johnst., *X. parvoincerta* Elix & J.Johnst., *X. praegnans* (Elix & P.M.Armstr.) Elix & J.Johnst., *X. subdecipiens* (Vain.) Hale, *X. subnuda* (Kurok.) Hale and *X. ustulata* (Kurok. & Filson) Elix & J.Johnst. On rare occasions, such variation can be observed in the one thallus, as in the type of *Parmelia schistacea* Kurok. & Filson. Here the marginal lobes are yellow in colour and contain usnic acid as the major cortical substance, while the older, interior lobes are grey and contain mainly atranorin. By contrast, the medullary chemistry (constipatic acid and protoconstipatic acid) does not vary between the inner and outer lobes. These variations in concentration of cortical components may be induced in response to light stress. The complementary nature of the ultraviolet-visible absorption spectra of usnic acid and atranorin would, in combination, provide a broader range of absorption properties and assist in the survival of the photobiont. Thus, like the other well-known parmelioid genera *Canoparmelia* Elix & Hale, *Hypotrachyna* (Vain.) Hale and *Parmotrema* Massal., *Xanthoparmelia* is now considered to accomodate species with both a yellow-green and grey upper surface, containing a preponderance of usnic acid and isousnic acid or atranorin, respectively. The results of a concurrent study on species of *Neofuscelia* will determine whether or not they too should also be included within *Xanthoparmelia*.

At this time, the expanded genus *Xanthoparmelia* can be described as follows.

Xanthoparmelia (Vain.) Hale, *Phytologia* **28**: 485 (1974)

= *Paraparmelia* Elix & J.Johnst. in Elix *et al., Mycotaxon* **27**: 279 (1986).

Description: Thallus foliose to subcrustose or rarely subfruticose, loosely adnate to very tightly adnate or rarely unattached. Lobes separate to imbricate, weakly concave or flat to strongly convoluted, irregular to linear, irregularly to dichotomously, trichotomously or digitately branched, 0.1-20 mm wide, eciliate, with or without lobules; apices ±incised. Upper surface pale yellow to yellow-green, yellow-grey to grey or grey-green, often darkening with age (usnic acid and/or isousnic acid and/or atranorin, ±minor amounts of chloroatranorin), smooth to rugulose, becoming transversely or irregularly cracked, rugose or areolate with age, maculate or not, without pseudocyphellae, rarely ±pruinose towards lobe apices, with or without dactyls, soredia and isidia; upper cortex consisting of basic palisade plectenchyma or vaulted paraplectenchyma, with a pored epicortex. Cell walls containing *Xanthoparmelia*-type lichenan. Medulla loosely packed, white or pigmented. Lower surface flat or canaliculate, smooth to rugose, pale ivory to yellow, tan or black, rarely pale yellow-green or orange; rhizines sparse to very dense or rarely absent, usually simple, tufted or not, rarely dichotomously or palmately branched. Ascomata apothecial, laminal, sessile to subpedicellate, rarely markedly innate or short pedicellate; disc imperforate, concave, often flattening and becoming convex, undulating or distorted with age, red-brown to brown or black. Ascospores ellipsoidal, 8 per ascus, 5-14 x 3.5-8 µm. Conidiomata pycnidial, immersed, usually laminal, punctiform. Conidia bifusiform, 4-9 µm long; rarely weakly fusiform, 4-14 µm long or bacilliform, 4-7 µm long.

Key characters of this genus include (see Elix 1993):

- thallus foliose, subcrustose or vagrant;
- thallus saxicolous or terricolous;
- pored epicortex present, pseudocyphellae absent;
- upper cortex yellow, yellow-green or grey, containing usnic acid or isousnic acid or atranorin;
- cell walls containing *Xanthoparmelia*-type lichenan;
- apothecia laminal, imperforate;
- ascospores ellipsoidal, 5-14 x 3.5-8 µm;
- pycnoconidia bifusiform, 4-9 x 1 µm;
- rhizines simple, rarely dichotomous or absent;
- lower surface pale ivory to jet black;
- the presence of medullary orcinol depsides, β-orcinol depsides, orcinol depsidones or β-orcinol depsidones, anthraquinones, aliphatic acids, amino-acid derivatives.

New Names and Combinations

A number of new names and combinations are necessary as a consequence of the reduction of *Paraparmelia* to synonymy.

Xanthoparmelia adusta (Kurok.) Elix, comb. nov.
Basionym: *Parmelia adusta* Kurok., *Bull. Natl Sci. Mus. Tokyo,* ser. B, **11**: 77 (1985).

Xanthoparmelia agamalis (Brusse) Elix, comb. nov.
Basionym: *Parmelia agamalis* Brusse, *Mycotaxon* **34**: 399 (1989).

Xanthoparmelia annexa (Kurok.) Elix, comb. nov.
Basionym: *Parmelia annexa* Kurok., in Hale & Kurokawa, *Contr. U.S. Natl Herb.* **36**: 151 (1964).

Xanthoparmelia aranaea (Elix & J.Johnst.) Elix, comb. nov.
Basionym: *Paraparmelia aranaea* Elix & J.Johnst., *Mycotaxon* **32**: 399 (1988).

Xanthoparmelia arcana (Kurok.) Elix, comb. nov.
Basionym: *Parmelia arcana* Kurok., in Hale & Kurokawa, *Contr. U.S. Natl Herb.* **36**: 151 (1964).

Xanthoparmelia aridella Elix, nom. nov.
Basionym: *Paraparmelia arida* Elix & J.Johnst., *Brunonia* **9**: 139 (1987) *non Xanthoparmelia arida* Egan & Derst., *Bryologist* **81**: 607 (1978).

Xanthoparmelia asilaris (Brusse) Elix, comb. nov.
Basionym: *Parmelia asilaris* Brusse, *Mycotaxon* **31**: 155 (1988).

Xanthoparmelia astricta (Brusse) Elix, comb. nov.
Basionym: *Parmelia astricta* Brusse, *Bothalia* **15**: 315 (1984).

Xanthoparmelia atrocapnodes (Elix & J.Johnst.) Elix, comb. nov.
Basionym: *Paraparmelia atrocapnodes* Elix & J.Johnst., *Brunonia* **9**: 141 (1987).

Xanthoparmelia ballingalliae (Elix & J.Johnst.) Elix, comb. nov.
Basionym: *Paraparmelia ballingallii* Elix & J.Johnst., *Mycotaxon* **32**: 400 (1988).

Xanthoparmelia barda (Brusse) Elix, comb. nov.
Basionym: *Parmelia barda* Brusse, *Bothalia* **17**: 25 (1987).

Xanthoparmelia basutoensis (Hale) Elix, comb. nov.
Basionym: *Parmelia basutoensis* Hale, *Bryologist* **75**: 342 (1972).

Xanthoparmelia bourgeanica (Elix) Elix, comb. nov.
Basionym: *Paraparmelia bourgeanica* Elix, *Mycotaxon* **59**: 410 (1996).

Xanthoparmelia brownlieae (Elix & J.Johnst.) Elix, comb. nov.
Basionym: *Paraparmelia brownlieieae* Elix & J.Johnst., *Mycotaxon* **32**: 400 (1988), as *brownlieii*.

Xanthoparmelia cerussata (Kurok.) Elix, comb. nov.
Basionym: *Parmelia cerussata* Kurok., *Bull. Natl Sci. Mus. Tokyo,* ser. B, **11**: 79 (1985).

Xanthoparmelia colensoides Elix, nom. nov.
Basionym: *Paraparmelia colensoica* Elix & J.Johnst., *Brunonia* **9**: 142 (1987) *non Xanthoparmelia colensoica* T.H.Nash, Elix & J.Johnst., *Mycotaxon* **33**: 355 (1988).

Xanthoparmelia columbariensis (Elix & J.Johnst.) Elix, comb. nov.
Basionym: *Paraparmelia columbariensis* Elix & J.Johnst., *Mycotaxon* **32**: 401 (1988).

Xanthoparmelia condyloides (Kurok.) Elix, comb. nov.
Basionym: *Parmelia condyloides* Kurok., in Hale, *Bryologist* **75**: 343 (1972).

Xanthoparmelia conranensis (Elix) Elix, comb. nov.
Basionym: *Parmelia conranensis* Elix, *Austral. J. Bot.* **29**: 20 (1981).

Xanthoparmelia crawfordensis (Elix) Elix, comb. nov.
Basionym: *Paraparmelia crawfordensis* Elix, *Biblioth. Lichenol.* **80**: 78 (2001).

Xanthoparmelia dwaasbergensis (Brusse) Elix, comb. nov.
Basionym: *Parmelia dwaasbergensis* Brusse, *Mycotaxon* **35**: 21 (1989).

Xanthoparmelia erebea (Brusse) Elix, comb. nov.
Basionym: *Parmelia erebea* Brusse, *Mycotaxon* **49**: 4 (1993).

Xanthoparmelia fausta (Brusse) Elix, comb. nov.
Basionym: *Parmelia fausta* Brusse, *Mycotaxon* **27**: 185 (1986).

Xanthoparmelia fumarprotocetrarica (Elix & J.Johnst.) Elix, comb. nov.
Basionym: *Paraparmelia fumarprotocetrarica* Elix & J.Johnst., *Mycotaxon* **32**: 403 (1988).

Xanthoparmelia fynbosiana (Elix) Elix, comb. nov.
Basionym: *Paraparmelia fynbosiana* Elix, *Biblioth. Lichenol.* **80**: 87 (2001).

Xanthoparmelia gemmulifera (Elix & T.H.Nash) Elix, comb. nov.
Basionym: *Paraparmelia gemmulifera* Elix & T.H.Nash, *Biblioth. Lichenol.* **80**: 88 (2001).

Xanthoparmelia gregaria (Elix & J.Johnst.) Elix, comb. nov.
Basionym: *Paraparmelia gregaria* Elix & J.Johnst., *Brunonia* **9**: 143 (1987).

Xanthoparmelia huttonii (Louwhoff & Elix) Elix, comb. nov.
Basionym: *Paraparmelia huttonii* Louwhoff & Elix, *Mycotaxon* **68**: 439 (1998).

Xanthoparmelia hypoconstictica (Elix & J.Johnst.) Elix, comb. nov.
Basionym: *Paraparmelia hypoconstictica* Elix & J.Johnst., *Brunonia* **9**: 144 (1987).

Xanthoparmelia inconspicuella Elix, nom. nov.
Basionym: *Paraparmelia inconspicua* Elix, *Mycotaxon* **59**: 411 (1996) *non Xanthoparmelia inconspicua* Hale, *Mycotaxon* **29**: 256 (1987).

Xanthoparmelia inops (Brusse) Elix, comb. nov.
Basionym: *Parmelia inops* Brusse, *Mycotaxon* **35**: 22 (1989).

Xanthoparmelia inselbergia (Elix) Elix, comb. nov.
Basionym: *Paraparmelia inselbergia* Elix, *Mycotaxon* **59**: 412 (1996).

Xanthoparmelia ischnoides (Kurok.) Elix, comb. nov.
Basionym: *Parmelia ischnoides* Kurok., in Hale & Kurokawa, *Contr. U.S. Natl Herb.* **36**: 155 (1964).

Xanthoparmelia juxtata (Elix) Elix, comb. nov.
Basionym: *Paraparmelia juxtata* Elix, *Biblioth. Lichenol.* **80**: 103 (2001).

Xanthoparmelia leucophaea (Elix & J.Johnst.) Elix, comb. nov.
Basionym: *Paraparmelia leucophaea* Elix & J.Johnst., *Mycotaxon* **32**: 403 (1988).

Xanthoparmelia lithophila (Kurok.) Elix, comb. nov.
Basionym: *Parmelia lithophila* Kurok., *Bull. Natl Sci. Mus. Tokyo,* ser. B, **11**: 83 (1985).

Xanthoparmelia lithophiloides (Kurok.) Elix, comb. nov.
Basionym: *Parmelia lithophiloides* Kurok., *Bull. Natl Sci. Mus. Tokyo,* ser. B, **11**: 84 (1985).

Xanthoparmelia lumbschii (Elix) Elix, comb. nov.
Basionym: *Paraparmelia lumbschii* Elix, *Mycotaxon* **59**: 413 (1996).

Xanthoparmelia maritima (Elix) Elix, comb. nov.
Basionym: *Paraparmelia maritima* Elix, *Mycotaxon* **70**: 107 (1999).

Xanthoparmelia molybdiza (Nyl.) Elix, comb. nov.
Basionym: *Parmelia molybdiza* Nyl., in Crombie, *J. Bot.* **14**: 19 (1876).

Xanthoparmelia mongaensis (Elix) Elix, comb. nov.
Basionym: *Parmelia mongaensis* Elix, *Austral. J. Bot.* **29**: 22 (1981).

Xanthoparmelia murina (Kurok.) Elix, comb. nov.
Basionym: *Parmelia murina* Kurok., *Bull. Natl Sci. Mus. Tokyo,* ser. B, **11**: 84 (1985).

Xanthoparmelia neomongaensis (Elix & J.Johnst.) Elix, comb. nov.
Basionym: *Paraparmelia neomongaensis* Elix & J.Johnst., *Mycotaxon* **32**: 404 (1988).

Xanthoparmelia neoquintaria (Hale) Elix, comb. nov.
Basionym: *Pseudoparmelia neoquintaria* Hale, *Smithsonian Contr. Bot.* **31**: 39 (1976).

Xanthoparmelia nimbicola (Brusse) Elix, comb. nov.
Basionym: *Parmelia nimbicola* Brusse, *Mycotaxon* **27**: 238 (1986).

Xanthoparmelia norcapnodes (Elix & J.Johnst.) Elix, comb. nov.
Basionym: *Paraparmelia norcapnodes* Elix & J.Johnst., *Mycotaxon* **32**: 406 (1988).

Xanthoparmelia norlobaridonica (T.H.Nash & Elix) Elix, comb. nov.
Basionym: *Paraparmelia norlobaridonica* T.H.Nash & Elix, *Mycotaxon* **29**: 468 (1987).

Xanthoparmelia numinbahensis (Elix) Elix, comb. nov.
Basionym: *Parmelia numinbahensis* Elix, *Austral. J. Bot.* **27**: 877 (1979).

Xanthoparmelia oveana (Elix) Elix, comb. nov.
Basionym: *Paraparmelia oveana* Elix, *Biblioth. Lichenol.* **80**: 141 (2001).

Xanthoparmelia perfissa (J.Steiner & Zahlbr.) Elix, comb. nov.
Basionym: *Parmelia perfissa* J.Steiner & Zahlbr., *Bot. Jahrb. Syst.* **60**: 519 (1926).

Xanthoparmelia pinguiacida (Elix & J.Johnst.) Elix, comb. nov.
Basionym: *Paraparmelia pinguiacida* Elix & J.Johnst., *Brunonia* **9**: 146 (1987).

Xanthoparmelia poeltii (T.H.Nash, Elix & J.Johnst.) Elix, comb. nov.
Basionym: *Paraparmelia poeltii* T.H.Nash, Elix & J.Johnst., *Mycotaxon* **32**: 406 (1988).

Xanthoparmelia pristiloba (Brusse) Elix, comb. nov.
Basionym: *Parmelia pristiloba* Brusse, *Mycotaxon* **49**: 8 (1993).

Xanthoparmelia prolata (Hale) Elix, comb. nov.
Basionym: *Parmelia prolata* Hale, *Bryologist* **75**: 344 (1972).

Xanthoparmelia pudens (Brusse) Elix, comb. nov.
Basionym: *Parmelia pudens* Brusse, *Mycotaxon* **27**: 188 (1986).

Xanthoparmelia roderickii (Elix & J.Johnst.) Elix, comb. nov.
Basionym: *Paraparmelia roderickii* Elix & J.Johnst., *Mycotaxon* **32**: 407 (1988).

Xanthoparmelia rugulosella Elix, nom. nov.
Basionym: *Paraparmelia rugulosa* Elix & J.Johnst., *Brunonia* **9**: 147 (1987) *non Xanthoparmelia rugulosa* Hale, *Mycotaxon* **30**: 328 (1987).

Xanthoparmelia saginata (Elix & J.Johnst.) Elix, comb. nov.
Basionym: *Paraparmelia seginata* Elix & J.Johnst., *Brunonia* **9**: 148 (1987).

Xanthoparmelia sammyi (Elix & J.Johnst.) Elix, comb. nov.
Basionym: *Paraparmelia sammyi* Elix & J.Johnst., *Mycotaxon* **32**: 408 (1988).

Xanthoparmelia sargentii (Elix & J.Johnst.) Elix, comb. nov.
Basionym: *Paraparmelia sargentii* Elix & J.Johnst., *Mycotaxon* **32**: 410 (1988).

Xanthoparmelia scabrosinita (Essl.) Elix, comb. nov.
Basionym: *Paraparmelia scabrosinita* Essl., *Bryologist* **103**: 588 (2000).

Xanthoparmelia schistacea (Kurok. & Filson) Elix, comb. nov.
Basionym: *Parmelia schistacea* Kurok. & Filson, in Kurokawa & Filson, *Bull. Natl Sci. Mus. Tokyo,* ser. B, **1**: 44 (1975).

Xanthoparmelia scotophylla (Kurok.) Elix, comb. nov.
Basionym: *Parmelia scotophylla* Kurok., in Kurokawa & Filson, *Bull. Natl Sci. Mus. Tokyo,* ser. B, **1**: 45 (1975).

Xanthoparmelia sitiens (Brusse) Elix, comb. nov.
Basionym: *Parmelia sitiens* Brusse, *Mycotaxon* **35**: 26 (1989).

Xanthoparmelia spodochroa (Kurok. & Filson) Elix, comb. nov.

Basionym: *Parmelia spodochroa* Kurok. & Filson, *Bull. Natl Sci. Mus. Tokyo,* ser. B, **1**: 45 (1975).

Xanthoparmelia subalpina (Elix & J.Johnst.) Elix, comb. nov.
Basionym: *Paraparmelia subalpina* Elix & J.Johnst., *Brunonia* **9**: 149 (1987).

Xanthoparmelia sublineola (Elix & J.Johnst.) Elix, comb. nov.
Basionym: *Paraparmelia sublineola* Elix & J.Johnst., *Mycotaxon* **32**: 411 (1988).

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Basionym: *Paraparmelia subrugulosa* Elix & J.Johnst., *Mycotaxon* **32**: 411 (1988).

Xanthoparmelia subspodochroa (Elix & J.Johnst.) Elix, comb. nov.
Basionym: *Paraparmelia subspodochroa* Elix & J.Johnst., *Brunonia* **9**: 150 (1987).

Xanthoparmelia subtortula (Hale) Elix, comb. nov.
Basionym: *Parmelia subtortula* Hale, *Phytologia* **27**: 3 (1973).

Xanthoparmelia subtropica (Elix & J.Johnst.) Elix, comb. nov.
Basionym: *Paraparmelia subtropica* Elix & J.Johnst., *Brunonia* **9**: 151 (1987).

Xanthoparmelia tortula (Kurok.) Elix, comb. nov.
Basionym: *Parmelia tortula* Kurok., in Hale & Kurokawa, *Contr. U.S. Natl Herb.* **36**: 157 (1964).

Xanthoparmelia tropica (Elix & J.Johnst.) Elix, comb. nov.
Basionym: *Paraparmelia tropica* Elix & J.Johnst., *Mycotaxon* **32**: 412 (1988).

Xanthoparmelia tzaneenensis (Elix) Elix, comb. nov.
Basionym: *Paraparmelia tzaneenensis* Elix, *Biblioth. Lichenol.* **80**: 191 (2001).

Xanthoparmelia usitata (Brusse) Elix, comb. nov.
Basionym: *Parmelia usitata* Brusse, *Bothalia* **52**: 107 (1986).

Xanthoparmelia valdeta (Elix) Elix, comb. nov.
Basionym: *Paraparmelia valdeta* Elix, *Biblioth. Lichenol.* **80**: 195 (2001).

Xanthoparmelia vanderbylii (Zahlbr.) Elix, comb. nov.
Basionym: *Parmelia vanderbylii* Zahlbr., *Ann. Crytog. Exot.* **5**: 252 (1932).

Xanthoparmelia violacea (Kurok.) Elix, comb. nov.
Basionym: *Parmelia violacea* Kurok., in Hale & Kurokawa, *Contr. U.S. Natl Herb.* **36**: 281 (1964).

Xanthoparmelia wirthii (Elix) Elix, comb. nov.
Basionym: *Paraparmelia wirthii* Elix, *Biblioth. Lichenol.* **80**: 200 (2001).

Xanthoparmelia xanthomelanella Elix, nom. nov.
Basionym: *Paraparmelia xanthomelanoides* Elix & T.H.Nash, *Mycotaxon* **29**: 469 (1987) *non Xanthoparmelia xanthomelanoides* Elix & J.Johnst., *Mycotaxon* **33**: 363 (1988).

Xanthoparmelia xerica (Elix) Elix, comb. nov.
Basionym: *Paraparmelia xerica* Elix, *Biblioth. Lichenol.* **80**: 203 (2001).

Xanthoparmelia yamblaensis (Elix) Elix, comb. nov.
Basionym: *Paraparmelia yamblaensis* Elix, *Mycotaxon* **47**: 115 (1993).

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PISOLITHUS HYPOGAEUS SP. NOV.: A HYPOGEOUS REPRESENTATIVE OF THE GENUS PISOLITHUS FROM WESTERN AUSTRALIA

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ABSTRACT

Pisolithus hypogaeus, the first record of a *Pisolithus* species with a hypogeous habit, occurs in coastal south-western Australia in association with eucalypt ectomycorrhizal hosts on sandy soils. Ribosomal DNA (rDNA) sequencing shows that *P. hypogaeus* lies within a lineage of other brown- and echinulate-spored *Pisolithus* spp., and is most closely related to two undescribed epigeous *Pisolithus* species from Australia.

KEYWORDS ectomycorrhiza, eucalypt, truffle-like, Sclerodermataceae, sequestrate

INTRODUCTION

Following the systematic arrangement in Kirk *et al.* (2001), as supported by the molecular phylogenetic studies of Binder and Bresinsky (2002), the family Sclerodermataceae includes five genera with species described from Australia: *Calostoma, Favillea, Horakiella, Scleroderma* and *Pisolithus*. *Calostoma* and *Favillea* contain only epigeal species. *Scleroderma* includes ca. 23 species with epigeal habit and up to 11 hypogeous species (Guzman 1970; Beaton and Weste 1982; Sims *et al.* 1995; JM. Trappe, M. Castellano and A. Claridge, unpublished data). The hypogeous genus *Horakiella* has one described species, with a further four undescribed species (Castellano and Trappe 1992; JM. Trappe, M. Castellano and A. Claridge, unpublished data). *Pisolithus* includes at least five validly described species (Kirk *et al.* 2001; Watling *et al.* 1995) but the molecular genetic studies by Cairney *et al.* (1999), Anderson *et al.* (2001) and Martin *et al.* (2002) indicate the presence of up to an additional eight species. Australian *Pisolithus* material has been partly revised and assigned provisional names (MJ. Priest, unpublished data) that have been cited in other works (Bougher and Syme 1998; Anderson *et al.* 2001; Martin *et al.* 2002).

No hypogeous representatives of *Pisolithus* have been reported to date. However, examination of numerous hypogeous Sclerodermataceae from south-western Australia has brought a new hypogeous *Pisolithus* species to our attention. Based upon analysis of rDNA sequences, *P. hypogaeus* sp. nov. is closely related to some epigeous brown-spored *Pisolithus* species.

MATERIALS AND METHODS

Air-dried material was sectioned by hand, rehydrated in 3% KOH and stained with 1 % Congo Red and Melzer's Reagent. Colours are as described in Kornerup and Wanscher (1969). An Olympus BH2 microscope was used for microscopy, and drawings were made using an Olympus LB drawing tube at 1000x magnification. Spore diameters exclude ornamentation. Sequencing of the internal transcribed spacers (ITS) of rDNA was as detailed in Dunstan *et al.* (2000). Genbank (Benson *et al.* 2000) accessions for ITS sequences are AY179746 (MURU5134) and AY179747 (MURU5417). Collections have been deposited in the Western Australia Herbarium (PERTH) and the herbarium of Murdoch University (MURU).

DESCRIPTION

Pisolithus hypogaeus S.R. Thomas, Dell & Trappe sp. nov.

A *Pisolithi* ceteri habitu hypogaeo, statura parvula basidiomatum, penuria basis radicantis, et maturatione simultanea sporarum differt. Holotypus hic designatus: MURU 5417, Australia Occidentalis, Stella Palus, leg. W. A. Dunstan, 9 Iulius 2000.

Basidiomata hypogeous, globose to slightly irregular, 7 – 12 mm, soot brown (near 5F5), with or without a basal depression and few basal hyphae; surface glabrous and dry with shallow pitting (to 1 mm), not rupturing at maturity, drying hard (Figure 1). *Peridium* 0.3 - 0.7 mm thick, wheat to butter yellow (4A5/4B5), not staining with exposure. *Gleba* never exposed, solid, dry, concolorous with the peridium, becoming darker yellow or brown when dried; comprised of irregularly shaped peridioles separated by tramal plates 25-170 µm wide. *Peridioles* persistent, 0.25 x 0.2 – 1.8 x 1 mm, filled with spores at maturity. Matrix frequently present.

Peridium persistent, 250 – 400 µm thick; two layered, suprapellis (120-150 µm thick) of loosely interwoven yellowish-brown hyphae (2 - 4 µm), subpellis (150 - 250 µm thick) of tightly bound interwoven hyaline hyphae (9 - 10 µm dia.) with few intercellular spaces, often constricted at septa (3.6 - 7.3 µm dia.), thin- (to 0.5 µm) or thick-walled (0.7 – 1.5 µm); clamp

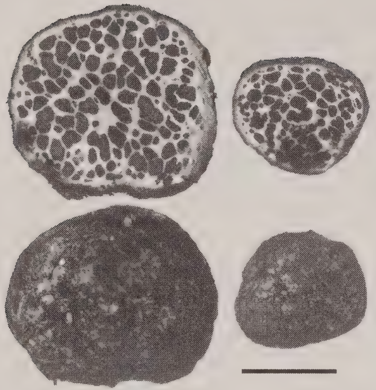

Figure 1: Basidiomata of *Pisolithus hypogaeus* (Holotype: MURU5417). Bar = 5 mm

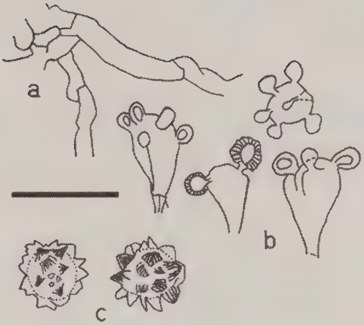

Figure 2: *Pisolithus hypogaeus* (a) tramal hyphae; (b) basidia; and, (c) spores (Holotype: MURU5417). Bar = 20 µm

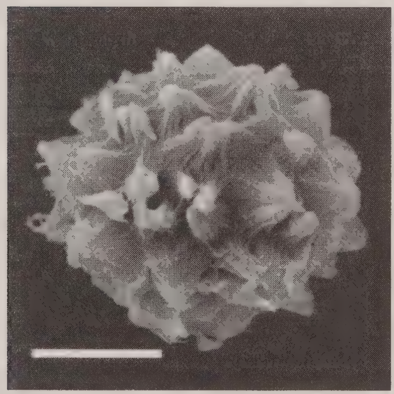

Figure 3: Pisolithus hypogaeus basidiospore (Holotype: MURU5417). Bar = 5 mm

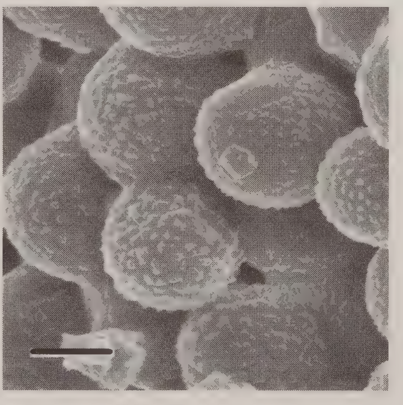

Figure 4: *Pisolithus hypogaeus* basidiospores (Paratype: MURU5023). Bar = 5 µm

connections present. *Trama* of parallel interwoven thin (1.5 - 2.2 μm dia.), hyaline hyphae, with thick (1.8 – 4.4 μm dia.) hyphae in the central layer between peridioles; clamp connections abundant (Figure 2a).
Basidia pyriform, 13.1-18.2 x 7.6 -10.2 μm, thin-walled, 4- (some 6-) spored, basal clamp connections not seen (Figure 2b), sometimes present in peridioles with mature spores. *Spores* in mass raw umber (near 5F8), dark brown in water and KOH, not changing in Melzer's reagent, blue in Cotton Blue; globose, 9.1 μm (6.2 – 12.3 μm), thick walled (1.2 μm), two-layered; hilar appendix inconspicuous. *Ornamentation* of variable sized cones (0.7 - 2.4 μm) comprised of coalesced or connivent echinulae, with ornaments sometimes separated from each other at the base, basal width similar to length (Figures 2c and 3) or reduced and crowded cones concealed within a matrix that forms short ridges between ornaments (Figure 4).

Etymology Growing or remaining below ground.
Distribution and Hosts Found in sandy soil up to 10 cm deep. Known only from *Eucalyptus* spp.-*Banksia* spp. woodland on the mainland (*E. marginata*, *E. gomphocephala* and *Corymbia calophylla*) and *Eucalyptus* spp. revegetated areas on calcareous soils on Rottnest Island (*E. camaldulensis, E. gomphocephala* and *E. platypus*) in coastal south-western Australia.
Collections Examined WESTERN AUSTRALIA: **Holotype** here designated, Star Swamp Reserve, Waterman, W.A. Dunstan, MURU5417, 09.vii.2000, (PERTH06232159); **Paratypes:** Rottnest Island, S.R. Thomas and L. Chapman, MURU5023, 20.vii.1999; S.R. Thomas and T. Thomas, MURU5134, 06.viii. 2000.

DISCUSSION

P. hypogaeus differs from other *Pisolithus* spp. in greatly reduced sporocarp size, hypogeous habit, lack of a rooting base and the manner of sporocarp maturation. In the material so far examined, mature spores are found throughout the sporocarp, in contrast with progressive maturation of spores and disintegration of the peridium and gleba from the apex to the base in other species of *Pisolithus. P. hypogaeus* also lacks the black tar-like matrix present in the immature peridioles of other *Pisolithus* spp. and spores are never dark brown or black at maturity.

Chamberlain (1995) found a high degree of intraspecific variation in basidiospore morphology of some Australian *Pisolithus* species. Examination of spores from a single sporocarp revealed differences in size, density and shape of ornamentation similar to the differences identified between *P. hypogaeus* mainland and Rottnest Island collections. Spores of *P. hypogaeus* from Rottnest Island (Figure 4) have reduced spore ornamentation when compared to the holotype (Figure 3). Rottnest Island has a long history of disturbance (Rottnest Island Authority 2002) and is isolated from the mainland by 18 km of ocean.

sequences of other *Pisolithus* spp. and *Scleroderma* spp. (Martin *et al.* 2002; Y. Chen, WA. Dunstan and B. Dell unpublished data), show that *P. hypogaeus* falls within lineage A1 of *Pisolithus* spp. (Martin *et al.* 2002), and is most closely related to an unnamed epigeal *Pisolithus* species from New South Wales (accession/isolate LJ30 in Anderson *et al.* 2001, Genbank accession AF270774, 93% ungapped sequence homology), and to *P. marmoratus* nom. prov. (Bougher and Syme 1998). Both species have dark brown spores with coalesced spines, similar to *P. hypogaeus*.

At first appearance, sporocarps of *P. hypogaeus* could be mistaken for hypogeous species of *Scleroderma* or *Horakiella*. However, spores in mass of *P. hypogaeus* remain brown at all stages of development, in contrast to most hypogeous *Scleroderma* spp. that have a white gleba in immature specimens and a brown-black to purple black spore mass at maturity (JM. Trappe, M. Castellano and A. Claridge, unpublished data). *Horakiella* spp. can be readily discriminated from *P. hypogaeus* by their spores with thicker walls and ornamentation of shallow lines, wrinkles, reticulation, or minute spines rather than coalesced spines of *P. hypogaeus* (Castellano and Trappe 1992).

Mycophagy is the assumed mode of spore dispersal in hypogeous fungal species, including the Sclerodermataceae. Over several years of research on Rottnest Island there has been evidence of hypogeous *Scleroderma* spp. in the scats of the Quokka (*Setonix brachyurus*; Macropodidae) (SR. Thomas unpublished data). Spores of *P. hypogaeus* have not been identified from Quokka scats. Given the general decline of other mammalian mycophagists within the known range of the fungus, insects are probably important in dispersal of spores of *P. hypogaeus* as adult Coleoptera (beetles) have been observed consuming *P. hypogaeus* basidiomes in the field.

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We are grateful to the Rottnest Island Authority (RIA) for access to Rottnest Island. Thomas was a recipient of an APA (I) SPIRT award when the bulk of this work was undertaken. Trappe participated under a grant to A. W. Claridge and J.M. Trappe from the Australian Biological Resources Study and used laboratory facilities courtesy of Dr. Randy Molina, U.S. Forest Service, Pacific Northwest Research Station.

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GYMNOPILUS PERPLEXUS, A NEW NAME FOR G. ANOMALUS B.J. REES

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ABSTRACT

Gymnopilus anomalus B.J. Rees is a homonym of *Gymnopilus anomalus* (Peck) Murrill and is replaced here by *Gymnopilus perplexus* B.J. Rees *nom. nov.*

Gymnopilus perplexus B.J. Rees *nom. nov.*

Holotype: Australia. Western Australia. Quininup, Northcliff Forest Park, *E. Horak*, 21.vi.1985. ZT 2708.

Basionym: *Galerina eucalyptorum* E. Horak, *Sydowia* **40**, 65-80 (1987), non *Gymnopilus eucalyptorum* (Cleland) Singer (1947).

Synonym: *Gymnopilus anomalus* B.J. Rees Mycotaxon **84**, 93-110 (2002) nom. illeg., non (Peck) Murrill, (1917).

Misapplied names: *Naucoria horizontalis* (Bull.) Quél. (1873) auct. non (Bull.) Quél: Cleland & Cheel (i) J. & Proc. Roy. Soc. New South Wales **48**, 436 (1914); (ii) Trans. & Proc. Roy. Soc. South Australia **42**,116-117 (1918); (iii) in *Toadstools and Mushrooms of South Australia* 1: 125-126 (1934).

Gymnopilus tyallus Grgur. *Larger Fungi of South Australia* pp. 127 (1997) pro parte.

Gymnopilus perplexus was incorrectly identified initially by Cleland & Cheel (1914) as *Naucoria horizontalis.* Cleland (1934) later described another similar, small-statured species as *Flammula eucalyptorum* which he regarded as more closely related to other Australian *Flammula* species.

Singer (1947), with no apparent knowledge of the characters of the species, recombined *Flammula eucalyptorum* as *Gymnopilus eucalyptorum* when describing a clearly different, large-statured species with an annulus occurring under eucalypts in Uruguay. He subsequently included *G. eucalyptorum* in Section *Annulati* of *Gymnopilus* (1951, 1962), but corrected the error by dropping the species from later editions.

Horak (1987), when describing a new group of *Galerina* species with excentric stipes, included a new species *Galerina eucalyptorum* and commented on its distinctly gymnopiloid features. This species was the same species described by Cleland as *Naucoria horizontalis* and all the features may be observed in the best preserved of Cleland's collections (Rees et al., 1999).

In a cladistic analysis of *Gymnopilus* species based on the ITS region of ribosomal DNA (Rees et al., 2002) *Galerina eucalyptorum* is nested among other *Gymnopilus* species, and has similar morphological characters. Stipe excentricity is not rare among other Australian *Gymnopilus* species and as a result the species was recombined. As the name *Gymnopilus eucalyptorum* was already in use for a clearly separate species, *Gymnopilus anomalus* was chosen as a nom. nov. for *Galerina eucalyptorum.* Subsequent checks by the author have revealed that this name was invalid, as it has already been used by Murrill (1917) to describe another species not now regarded as a *Gymnopilus* species (Hesler 1969).

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MYCOTAXON

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GOOSIA, A NEW GENUS OF ENGLERULACEAE

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ABSTRACT

A new genus of Englerulaceae, *Goosia*, is proposed, with its type *Goosia melastomatis*, sp. nov., parasitic on *Melastoma normale* (Melastomataceae) from China.

Key words: *Goosia melastomatis*, new species, China.

During a study of asterinaceous fungi in China, au unusual englerulaceous fungus was discovered, for which a new genus, is proposed.

Goosia B. Song, gen. nov.

Coloniae foliicolae, superficiales, atrae, densae, velutinae. Hypha foliicolae, superficiales. Appressoria atro-brunnea. Phialides 1-cellula, subampullacea. Ascomata ex hypha stipitata singulata atra ellipsoidea vel elongate ellipsoidea oriunda, non ostiolata ad centrum. Asci ovata, 2-ascospora. Ascosporae atro-brunneae, 1-septatae. Conidia unicellularia, atro-brunnea.

Colonies foliicolous, superficial, black, densely velutinous. Hyphae foliicolous, superficial. Appressoria brown. Phialides 1-celled, nearly ampulliform. Ascomata on hyphae, stipitate, single, black, ellipsoid or elongate-ellipsoid, non ostiolate at centre. Asci ovate, with 2 spores. Ascospores brown, 1-septate. Conidia unicellular, brown.

Etymology: This new genus is named in honour of Prof. Roger D. Goos of Department of Botany, University of Rhode Island (USA).

The morphological characters of the ascomata and the appressoria on hyphae of this fungus are similar to those found in *Thrauste*, but differ in having phialides. Therefore, a new genus is proposed, and is placed in the Englerulaceae. The characters suggest a close relationship to meliolaceous fungi.

Type species: *Goosia melastomatis* B. Song.

Goosia melastomatis B. Song sp. nov. (Fig. 1)

Coloniae amphigenae, plerumque epiphyllae, atrae, tenues, arachnoideae vel subvelutinae, ad 4 mm diam. Hyphae atro-brunneae, subrectae vel sinuatae, acuteque vel obtuseque oppositae vel irregulariter ramosae, laxe vel dense reticulatae, cellulis 20-38×5.3-6.5μm. Appressoria unicellularia, alternata vel unilateralia, antrorsa, plerumque recta vel subrecta, subglobosa vel globosa, latiora et apicem, integra, 10-15×10-14 μm. Phialides appressoriis immixtae, paucae, alternatae, subampullaceae, 8-13×5-8.5 μm. Ascomata ex hyphaoriunda, singularia, dispersa,

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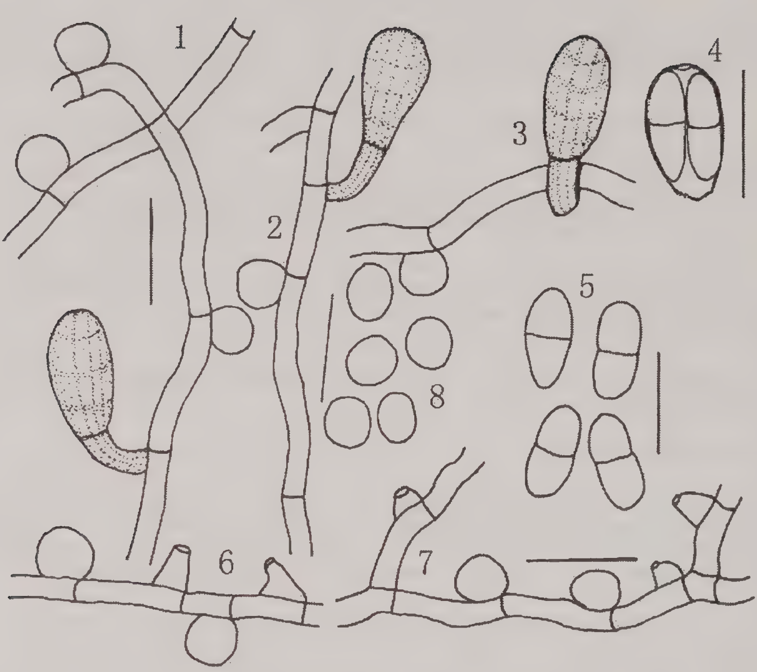
*This project was supported by the Natural Science Foundation of Guangdong(20000205; 020470), the Outstanding Youth Foundation of Academy of Guangdong Province, the Foundation of Guangdong Institute of Microbiology, and the Guangdong Provincial Laboratory of Microbial Culture Collection and Application.



Figs. 1-8. *Goosia melastomatis*
Fig.1-3. hyphae with appressoria and ascomata; Fig.4. ascus; Fig.5. ascospores; Fig.6-7. hyphae with appressoria and phialides; Fig.8. conidia. (Bars=25μm)

atra, monoasci, ellipsoidea vel elongate ellipsoidea, parva, 20-35 μm longa et 12-19 μm lata, non ostiolata ad centrum, stipitata subcylindracea, 12.5-20 μm longa et 5-7 μm lata. Asci ovata, 2-ascospora, 25-29×14-16 μm. Ascosporae oblongae vel ellipsoideae, atro-brunneae, 1-septatae, obtusae, constrictae, laeves, 18-24×8-11 μm. Conidia unicellularia, globosa vel subglobosa, atro-brunnea, 7-12×6-9 μm.

Colonies amphigenous, mostly epiphyllous, black, thin, arachnoid or nearly velvety, up to 4 mm in diameter. Hyphae brown, nearly straight or sinuous, acutely or obtusely opposite or irregular branching, loosely to closely reticulate, cells 20-38×5.3-6.5 μm. Appressoria unicellular, alternate or unilateral, spreading, mostly straight or nearly straight, nearly globose or globose, wide at apex, entire, 10-15×10-14 μm. Phialides few, mixed with appressoria, alternate, nearly ampulliform, 8-13×5–8.5 μm. Ascomata on hyphae, singular, scattered, black, monoascal, ellipsoid or elongate-ellipsoid, small, 20-35 μm long and 12-19 μm wide, non ostiolate, stipitate, stipe nearly cylindrical, 12.5-20 μm long and 5-7 μm wide. Asci ovate, 2-ascospores, 25-29×14-

16 µm. Ascospores oblong or ellipsoid, brown, 1-septate, obtuse, constricted, surface smooth, 18-24×8-11 µm. Conidia unicellular, globose or nearly globose, brown, 7-12×6-10 µm.

Holotype: On leaves of *Melastoma normale* D. Don (Melastomataceae). Diaolou Shan, Hainan Province, China. May 28, 1988, Y. X. Hu, HMIGD 34601.

Etymology: *melastomatis*, in reference to the host, *Melastoma normale*.

Morphological characters of *G. melastomatis* are somewhat similar to those of *Thrauste medinillae* (Rac.) Theiss. The main distinguishing feature of *T. medinillae* are that the phialides are absent and the ascospores are larger (25-30×14-18 µm)(Saccardo,1926; Müller & von Arx, 1962).

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The author is deeply grateful to Dr. J. Y. Zhuang, Systematic Mycology & Lichenology Laboratory, Institute of Microbiology, Academia Sinica, for correction of the Latin descriptions, Dr. Richard P. Korf for advice on the manuscript, and to Dr. R. D. Goos of Department of Botany, University of Rhode Island (U.S.A.) for reviewing the manuscript. The author also acknowledges Prof. S. Q. Chen of the South China Institute of Botany, Academia Sinica, Guangzhou, for identifying the host plant.

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TWO NEW ASTERINA SPECIES FROM HAINAN, CHINA*

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ABSTRACT

Asterina microcosi parasitic on *Microcos paniculata* and *Asterina olacis* parasitic on *Olax wightiana* are described and illustrated as new species.

Key words: Asterinaceae, *Asterina microcosi*, *Asterina olacis*.

A recent critical restudy of specimens deposited in the Herbarium of Guangdong Institute of Microbiology (HMIGD), Guangzhou (China) shows that at least two separate taxa of the genus *Asterina* occurring in Hainan Province (China) are at present incorrectly assigned. They are described and illustrated as new species.

1. ***Asterina microcosi*** B. Song, sp. nov. (Fig. 1)

Coloniae hypophyllae, atrae, tenues, arachnoideae vel subvelutinae, ad 3 mm diam., plerumque confluentes. Hyphae atro-brunneae, plerumque sinuatae, irregulariter acuteque vel wideque ramosae, laxe reticulatae, cellulis plerumque 12-23×2.5-3.5 µm. Appressoria uicellula, alternata vel unilatera, antrorsa, sinuata vel subrecta, 2-3-lobata, 7.5-9×7.5-8.5 µm. Ascomata dispersa, atra, orbiculata vel hemisphaeria, ad 110 µm diam., stellate dehiscentia ad centrum, irregulariter margina crenata vel fimbriata, cells 2.5-3.5 µm lata. Ascosporae suboblongae, atro-brunneae, 1-septatae, obtusae, constrictae, laeves, 17.5-19.5×8.5-10 µm. Pycnidia pauca, dispersa, hemisphaeria, stellate dehiscentia ad centrum, irregulariter crenata ad peripherica, ad 100 µm diam. Conidia unicellula, subovata, atro-brunnea, 11-12.5×9.5-10 µm.

Colonies hypophyllous, black, thin, arachnoid or nearly velvety, up to 3 mm in diameter, mostly confluent. Hyphae brown, mostly sinuous, irregularly branching acutely or lately, loosely reticulate, cells mostly 12-23×2.5-3.5 µm. Appressoria unicellular, alternate or unilateral, spreading, bent or nearly straight, 2-3-lobate, 7.5-9×7.5-8.5 µm. Ascomata scattered, black, orbicular to hemispherical, up to 110 µm in diameter, stellulately dehisced at the centre, irregularly crenate to short tassels at periphery, surface cells 2.5-3.5 µm wide. Ascospores nearly oblong, brown, 1-septate, obtuse, constricted at septum, surface smooth, 17.5-19.5×8.5-10 µm. Pycnidia few, similar ascomata, scattered, hemispherical, stellulately dehisced at the centre, irregularly crenate at periphery, up to 100 µm in diameter. Conidia unicellular, nearly ovate, brown, 11-12.5×9.5-10 µm.

Holotype: On leaves of *Microcos paniculata* Linn.(Tiliaceae). Hainan Province, China. August, 1988, Y. X. Hu, HMIGD 34240.

Etymology: *microcosi*, in reference to the host species, *Microcos paniculata*.

The present species is closely related to *Asterina triumfetticola* Yam. The distinguishing character feature of *A. triumfetticola* are that the ascospores are echinulate and conidia are larger

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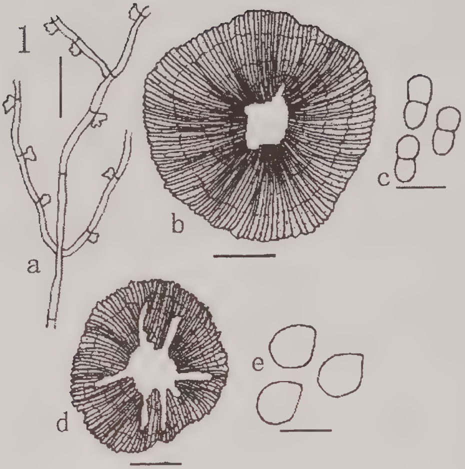

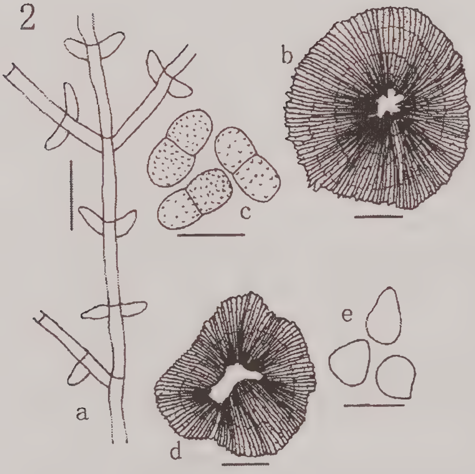

Fig.1 *Asterina microcosi* (a. hyphae with appressoria; b. ascomata; c. ascospores; d. pycnidium; e. conidia). (Bars=25μm).

Fig.2 *Asterina olacis* (a. hyphae with appressoria; b. ascomata; c. ascospores; d. pycnidium; e. conidia). (Bars=25μm).

(14-18.5×14-16 µm) (Yamamoto, 1957).

This is the first record of the genus *Asterina* on *Microcos*.

2. *Asterina olacis* sp. nov. (Fig. 2)

Coloniae amphigenae, atrae, tenues vel subdensae, arachnoideae vel velvulae, ad 2 mm diam., raro confluentes. Hyphae atro-brunneae, subrectae, opposite acuteque vel wideque ramosae, laxe vel dense reticulatae, cellulis plerumque 18-28×5.5-7.5 µm. Appressoria uicellula, opposita vel 2% alternata, antrorsa, recta vel subsinuata, subcylindracea vel conoidea, subacuta et apice, integra, 6-17×5-8 µm. Ascomata laxe aggregata vel dispersa, atra, orbiculata vel hemisphaeria, ad 170 µm diam., nulla cava vel stellate dehiscentia ad centrum, irregulariter margina crenata vel fimbriata, cells 2-3 µm lata. Ascosporae oblongae vel ellipsoideae, atro-brunneae, 1-septatae, obtusae, constrictae, echinulatae, 31-37×16-18 µm. Pycnidia numera, atra, dispersa vel laxe aggregata, hemisphaeria, stellulate dehiscentia ad centrum, irregulariter crenata ad peripherica, ad 100 µm diam. Conidia unicellula, subovata, atro-brunnea, 20-27×16-18 µm.

Colonies amphigenous, black, thin to nearly dense, arachnoid or velvety, up to 2 mm in diameter, rarely confluent. Hyphae brown, nearly straight, opposite branching acutely or lately, loosely or closely reticulate, cells mostly 18-28×5.5-7.5 µm. Appressoria unicellular, opposite or 2% alternate, spreading, straight or slightly bent, nearly cylindrical or conoid, nearly acute at apex, entire, 6-17×5-8 µm. Ascomata lax aggregate to scattered, black, orbicular or hemispherical, up to 170 µm in diameter, no hole or stellulately dehiscent at the center, irregularly crenate to shortly tasseled at periphery, surface cells 2-3 µm wide. Ascospores oblong or ellipsoid, brown, 1-septate, obtuse, constricted at septum, surface echinulate, 31-37×16-18 µm. Pycnidia numerous, black, scattered or lax aggregate, hemispherical, up to 100 µm in diameter, stellulately dehisced at the center, irregularly crenate at periphery. Conidia unicellular, nearly ovate, brown, 20-27×16-18 µm.

Holotype: on leaves of *Olax wightiana* Wall. ex Wight. & Arn.(Olaceae). Hainan Province, China. September 9, 1975, D. H. Ye, HMIGD 34351.

Etymology: *olacis*, in reference to the host species, *Olax wightiana*.

The present species is closely related to *Asterina olacicola* Hansf. The distinguishing character feature of *A. olacicola* are that the ascospores are smaller (27-32×13-15 µm) and surface smooth (Hansford, 1947).

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We are deeply grateful to Dr. R. D. Goos of Department of Botany, University of Rhode Island (U.S.A.) for reviewing the manuscript. We also acknowledges Prof. S Q Chen of South China Institute of Botany, Academia Sinica, Guangzhou, for identifying the host plants, and to Ms. A.L. Zhang for the technical assistance.

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SIX TAXA OF MELIOLACEAE FROM YUNNAN PROVINCE IN HKAS, CHINA*

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ABSTRACT

An account is given of six meliolaceous fungi from Yunnan Province, China. Two new species, viz. *Asteridiella craibiodendri* and *Meliola zangii* are described. Specimens examined are deposited in Cryptogamic Herbarium of Kunming Institute of Botany, Academia Sinica (HKAS), Kunming, China.

Key words: *Asteridiella craibiodendri, Meliola zangii*

Asteridiella craibiodendri B. Song, sp. nov. (Fig. 1)

Coloniae amphigenae, plerumque epiphyllae, atrae, densae, arachnoideae vel velutinae, ad 3 mm diam., plerumque confluent. Hyphae atro-brunneae, subrectae vel sinuatae, opposite plerumque acuteque ramosae, dense reticulatae, cellulis plerumque 18-26×7-8.5 μm. Appressoria alternata vel unilatera, antrorsa, sinuata vel recta, 20-33 μm longa; cellulae basilares cylindraceae vel cuneatae, 7.5-10 μm longae; cellulae apicales ovatae vel ellipsoideae, irregulariter 2-4 lobatae vel subintegrae, 15-22.5×13-15 μm. Phialides et illis appressoria immixta, oppositae vel alternatae, dispersae, ampullaceae, 25-40×10-18 μm. Setae myceliales nullae. Perithecia aggregata, nigra, globosa, ad 150 μm diam., verrucosa conoidea vel mammiformia, 15-25 μm alta, basi circa 14-24 μm. Ascosporae atro-brunneae, subcurvae, fusoideae vel subellipsoideae, obtusae, 3-septatae, constrictae, 40-44×16-18 μm.

Colonies amphigenous, mostly epiphyllous, black, dense, arachnoid or velvety, up to 3 mm in diameter, mostly confluent. Hyphae brown, nearly straight or mostly sinuous, oppositely branching acutely, closely reticulate, cells mostly 18-26×7-8.5 μm. Appressoria in alternate or unilateral arrangement, spreading, sinuate or straight, 20-33 μm long; stalk cells cylindric to cuneate, 7.5-10 μm long; head cells ovate or ellipsoid, irregulariter 2-4 lobate or nearly entire, 15-22.5×13-15 μm. Phialides mixed with appressoria, opposite or alternate, scattered, ampulliform, 25-40×10-18 μm. Mycelial setae absent. Perithecia aggregate, black, globose, up to 150 μm in diameter; verrucose cells conoid to mammillate, projecting up to 15-25 μm, at base 14-24 μm. Ascospores brown, nearly bent, fusoid or nearly ellipsoid, obtuse, 3-septate, constricted, 40-44×16-18 μm.

Holotype: On leaves of *Craibiodendron* sp.(Ericaceae). Gungshan, Yunnan Province, China. August 6, 1982, M. Zang, HKAS 10835.

Etymology: *craibiodendri*, in reference to the host species, *Craibiodendron* sp.

The present species is closely related to *Asteridiella gaylussaciae* Hansf. var. *craibiodendri* Jiang (1995). The distinguishing character feature of *A. gaylussaciae* var. *craibiodendri* are that the ascospores are cylindric and larger (49.7-54.2×15.8-20.2 μm).

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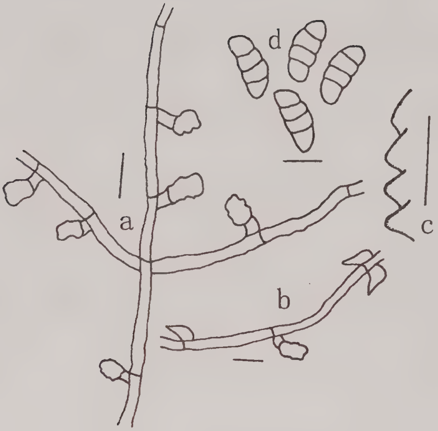

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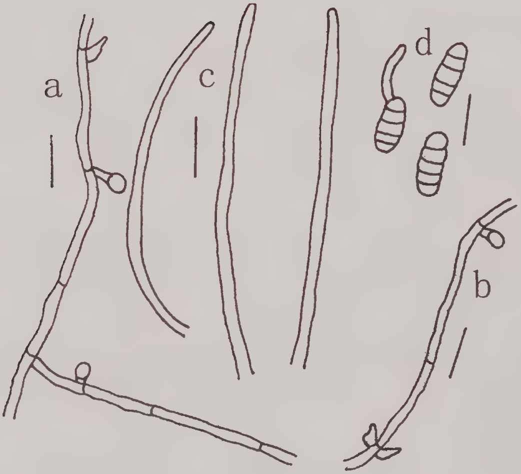

Fig.1 *Asteridiella craibiodendri* (a. hyphae with appressoria; b. hyphae with appressoria and phialides; c. verrucose cells; d. ascospores). (Bars=25μm)

Fig.2 *Meliola zangii* (a. hyphae with appressoria; b. hyphae with appressoria and phialides; c. mycelial setae; d. ascospores). (Bars=25μm)

Meliola butleri Syd., Ann. Mycol. Berlin 9:379. 1911
On leaves of *Citrus grandis* (L.) Osbeck(Rutaceae). Menglu, Yunnan Province, China. August 29, 1982, J. X. Xi, HKAS 10157.

Meliola quercina Pat., Journ. Bot. 4:61. 1890.
On leaves of Fagaceae indet. Menghai, Yunnan Province, China. October 11, 1974, M.Zang, HKAS 2014.

Meliola shiiae Yam., Trans. Nat. Hist. Soc. Soc. Formosa 31:126. 1941
On leaves of *Cyclobalanopsis* sp.(Fagaceae). Menghai, Yunnan Province, China. October 11, 1974, M. Zang, HKAS 1990.

Meliola viburni Syd., Ann. Mycol. 15:193. 1917
On leaves of *Viburnum* sp.(Caprifoliaceae). Weixiweideng, Yunnan Province, China. May 18, 1982, L.S. Wang, HKAS 9706, 9981.

Meliola zangii B. Song, sp. nov. (Fig. 2)

Coloniae amphigenae, plerumque hypophyllae, atrae, velutinae, dispersae, ad 3 mm diam., raro confluentes. Hyphae atro-brunneae, undulatae, irregulariter ramosae, dense reticulatae, cellulis plerumque 25-30×5-6 μm. Appressoria alternata to dispersa, antrorsa, plerumque subrecta, 10-20 μm longa; cellulae basilares cylindraceae, 2-8 μm longae; cellulae apicales ovatae, integrae, 8-12×7-9.5 μm. Phialides et illis appressoria immixta, alternatae vel raro oppositae, dispersae, ampullaceae, 15-18×6-7μm. Setae myceliales dispersae, atrae, simplices, rectae vel curvulae, apice obtusae, ad 200 μm longae vel basis 6-7 μm latae. Perithecia dispersa, nigra, globosa, verrucosa, ad 150μm diam. Ascosporae atro-brunneae, oblongae, obtusae, 4-septatae, constrictae, 30-35×10-13 μm.

Colonies amphigenous, mostly hypophyllous, black, velvety, scattered, up to 3 mm in diameter, rarely confluent. Hyphae brown, undulate, irregularly branching, closely reticulate, cells mostly 25-30×5-6 μm. Appressoria in alternate arrangement, scattered, spreading, mostly nearly straight, 10-20 μm long; stalk cells cylindrical, 2-8 μm long; head cells ovate, entire, 8-12×7-9.5 μm. Phialides mixed with appressoria, in alternate to rarely opposite arrangement, scattered, ampulliform, 15-18×6-7 μm. Mycelial setae scattered, black, simple, straight to curved, obtuse at apex, up to 200 μm long, 6-7 μm broad at base. Perithecia scattered, black, globose, verrucose, up to 150 μm in diameter. Ascospores brown, oblong, obtuse, 4-septate, constricted at septa, 30-35×10-13 μm.

Holotype: On leaves of *Ficus* sp.(Moraceae). Menghai, Yunnan Province, China. September 22, 1974, M. Zang, HKAS 1558.

Etymology: this species is named in honour of the Prof. M. Zang of Cryptogamic Herbarium, Kunming Institute of Botany, Academia Sinica, for his outstanding contributions to study on the fungi from China.

The present species is closely related to *Meliola bangalorensis* Hansf. & Thirum. The distinguishing character feature of *M. bangalorensis* are that the ascospores are larger (33-40× 13-15 μm), the mycelial setae are obtuse at apex, the head cells subglobose to clavate, and the hyphae oppositely branching (Hansford,1961; Hosagoudar *et al.*, 1997).

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We are deeply grateful to Dr. R. D. Goos of Department of Botany, University of Rhode Island (U.S.A.) for reviewing the manuscript. We also acknowledge Prof. F. W. Xing of South China Institute of Botany, Academia Sinica, Guangzhou, for identifying the host plants, and Prof. Dr. Zu L. Yang and Prof. L. S. Wang of Cryptogamic Herbarium of Kunming Institute of Botany, Academia Sinica (Kunming) for their help in various ways.

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GLOMUS TRIMURALES, AN ARBUSCULAR MYCORRHIZAL FUNGUS (GLOMERALES) NEW FOR POLAND AND EUROPE

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Abstract

The ontogenetic development and morphological properties of spores and vesicular-arbuscular mycorrhizae of *Glomus trimurales* (Glomerales), a fungus recovered from maritime sand dunes of northwestern Poland, are presented. This species had not been recorded previously in Poland and Europe. Spores of *G. trimurales* from Poland are yellowish-white to golden-yellow and have one wall comprising three layers: a hyaline to orange-white outermost layer ornamented with thickenings or blister-like outgrowths, a yellowish-white to golden-yellow, smooth or slightly wrinkled, rigid middle layer, and a hyaline, laminated innermost layer consisting of easily stratifying sublayers. No spore wall layers of *G. trimurales* stain in Melzer's reagent. Mycorrhizae formed by this fungus in one-species cultures with *Plantago lanceolata* consisted of arbuscules, vesicles, as well as intra- and extramatrical hyphae staining darkly in trypan blue. The properties of *G. trimurales* revealed are compared with those given in the original description of this fungus and those observed in preserved spores of a voucher material. Additionally, the know distribution of this fungus in the world is presented.

***Key Words*:** arbuscular fungi, Glomeromycota, mycorrhizae

Introduction

Examination of field-collected soils and those coming from pot trap cultures originating from maritime sand dunes of northwestern Poland revealed spores of *Glomus trimurales* Koske & Halvorson (Glomerales), an arbuscular mycorrhizal fungus known previously only from the U.S.A. This fungus was subsequently propagated in one-species pot cultures to determine the ontogenetic development and morphological properties of its spores, as well as the characters of the mycorrhizae formed.

Glomus trimurales had not been earlier recorded in Poland and Europe. Additionally, the appearance of its mycorrhizae is undescribed. The aims of this paper are to describe the properties of spores and mycorrhizae of *G. trimurales* coming from Poland and to compare them with those given by Koske and Halvorson (1989). The known distribution of this fungus in the world is also presented.

Materials and Methods

Collection of soil samples, establishment of trap and single-species pot cultures, as well as growth conditions generally are as those described previously (Błaszkowski and Tadych 1997). Briefly, rhizosphere soils and roots of sampled plants were collected from a depth of 5-30 cm using a small garden shovel. In the laboratory, about 200-g subsamples were taken from each sample for wet-sieving and decanting (Gerdemann and Nicolson 1963) to determine the species of arbuscular fungi sporulating in the field. Then, the remaining soil-root mixtures were either air-dried for 2 weeks and subsequently refrigerated at 4°C or directly used to establish trap cultures. Trap cultures were established to obtain large numbers of living spores of different developmental stages and to initiate sporulation of non-sporulating species in the field conditions. The growing substrate of the trap cultures was the field-collected material mixed with an autoclaved sand coming from maritime dunes adjacent to Świnoujście (pH 6.7; 12 and 26 mg L^{-1} P and K, respectively). These mixtures were placed in 15-cm plastic pots (1350 cm^3) and seeded with *Plantago lanceolata* L. as the plant host. At least 100 seeds were added to each pot.

Plants were grown in a greenhouse at 15-30°C with supplemental 8-16-h lighting provided by one SON-T AGRO sodic lamp (Philips Lighting Poland S. A.) placed 1 m above pots. The maximum light intensity was 180 µE $m^{-2}s^{-1}$ at pot level. Plants were watered 2-3 times a week. No fertilizer was applied during the growing period. Trap cultures were harvested at approximately 1-month intervals, beginning 3 months and ending 11 months after plant emergence. Spores were extracted by wet sieving and decanting (Gerdemann and Nicolson 1963). Presence of mycorrhizae was determined following clearing and staining of roots. Based on the experience of the authors of this paper and suggestions of Professor R. E. Koske, Rhode Island University, U. S. A., two changes were introduced to the original method given by Phillips and Hayman (1970). First, roots earlier cleared in 10% KOH were acidified in 20% HCl instead of 1% HCl as in the original procedure. Second, the concentration of trypan blue was increased from 0.05% to 0.1%.

Single-species pot cultures were established from about 50 to 100 newly formed spores stored before inoculation in water at 4°C for 24 h. After removing soil debris, spores were collected in a pipette and transferred onto a compact layer of roots of 10-14-day-old seedlings of *P. lanceolata* placed at the bottom of a hole of *ca* 1 cm wide and 4 cm deep formed in a wetted growing medium filling 8-cm plastic pots (250 cm^3). The growing medium was an autoclaved sand of maritime dunes adjacent to Świnoujście and with the chemical properties given above. Subsequently, the spores were covered with another layer of roots coming from 4-6 plants of the host. Finally, the roots and sandwiched spores were buried in the growing medium. The cultures were harvested after 4-12 months and spores extracted.

Developmental stages of the fungus were determined based on newly formed spores extracted from both trap and single species cultures, the latter being harvested at *ca* 20-30-day intervals.

Morphological properties of spores, their subcellular structures and developmental stages during differentiation were determined based on at least 100 spores mounted in polyvinyl alcohol/lactic acid/glycerol (PVLG; Koske and Tessier 1983) and a mixture of PVLG and Melzer's reagent (1:1, v/v). The spores represented all stages of differentiation of the fungus. The degree of maturity of spores was assessed based on their appearance under an Olympus SZX9 dissecting microscope. The main properties considered were color and size of spores. Spores were crushed to varying degrees by applying pressure to the coverslip and then stored at 65°C for 24 h to clear their contents of oil droplets. Examination of such prepared specimens was performed using an Olympus compound microscope equipped with differential interference contrast optics.

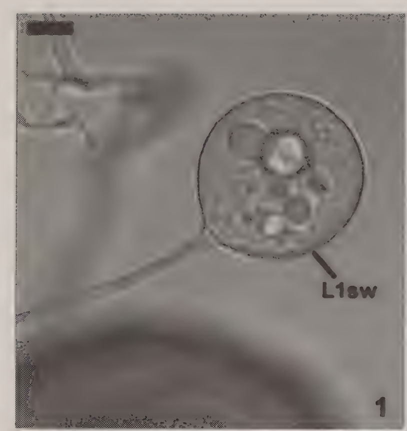
Terminology of spore structure is that suggested by Spain et al. (1989), Stürmer and Morton (1997), and Walker (1983). The classification used is that proposed by Schüßler et al. (2001). Spore color was examined under a dissecting microscope on fresh specimens immersed in water. Color names are from Kornerup and Wanscher (1983). Specimens were mounted in PVLG on slides and deposited in the Department of Plant Pathology (DPP), University of Agriculture, Szczecin, Poland.

Descriptions of the species

Glomus trimurales Koske & Halvorson Figs. 1-12

Sporocarps unknown. Spores borne singly in the soil; (Figs. 1, 3); produced from straight sporophores.

Figs. 1-12. Morphology of intact spores, subcellular structure of crushed spores of *Glomus trimurales* and appearance of its mycorrhizae in *Plantago lanceolata* roots stained in 0.1% trypan blue. **1.** Most juvenile spore with spore wall layer 1 (L1sw) only. **2.** Juvenile spore with spore wall layers 1 (L1sw) and 2 (L2sw). **3.** Intact mature spores. **4.** Spore wall layers 1-3 (L1-L3sp). **5.** Spore wall layers 1 and 2 (L1 and L2sw) separated from spore wall layer 3 (L3sw) and blister outgrowths (b) on spore wall layer 1 of a mature spore. **6.** Slightly deteriorated spore wall layer 1 (L1sw) adherent to spore wall layers 2 and 3 (L1 and L2sw). **7.** Highly deteriorated spore wall. Layer 1 (L1sw) adherent to spore wall layer 2 (L2sw), the latter separated from stratified spore wall layer 3 (L3sw). **8.** Spore wall layers 1-3 (L1-L3sw); note the sloughing layer 1 (compare with Fig. 4) and the highly stratified layer 3. **9.** Intraradical hyphae (hyp) and arbuscules (arb). **10.** Vesicles (ves) and intraradical hyphae (hyp). **11.** Hyphal coils (coi) and straight hyphae (hyp). **12.** Wall layers 1-3 (L1-L3sw) of a spore from the slide no. 2317 of R. E. Koske. Fig. 3, bright field microscopy; Figs. 1, 2, 4-12, differential interference contrast. Bars: Figs. 1, 2, 4-12=10 μm; Fig. 3=20 μm.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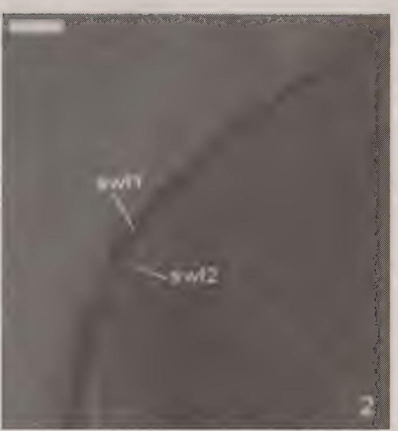
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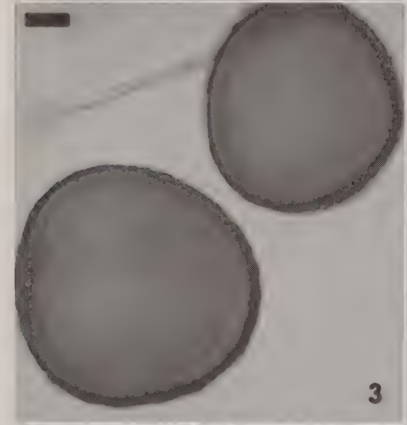
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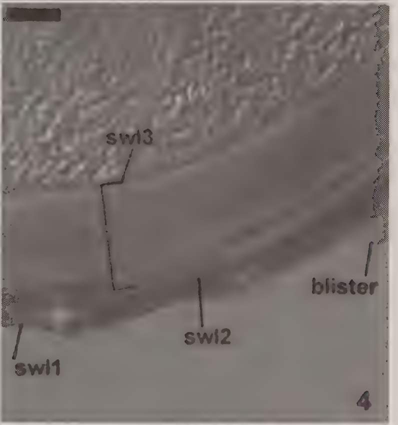
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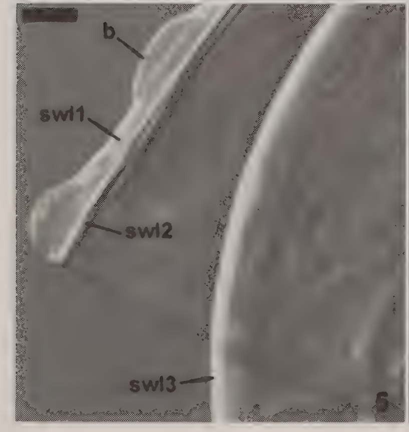
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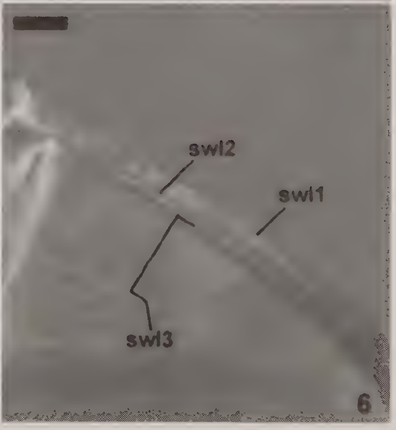
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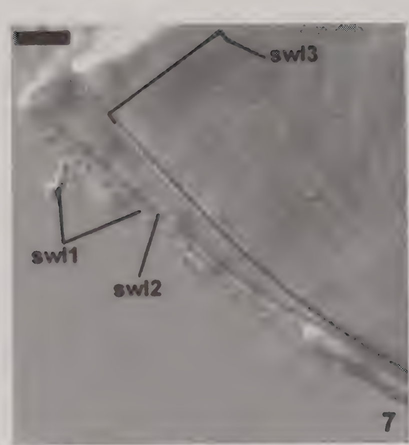
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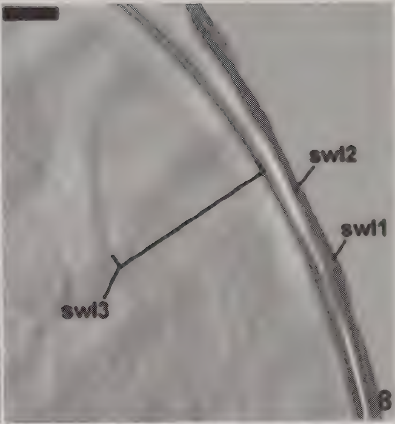
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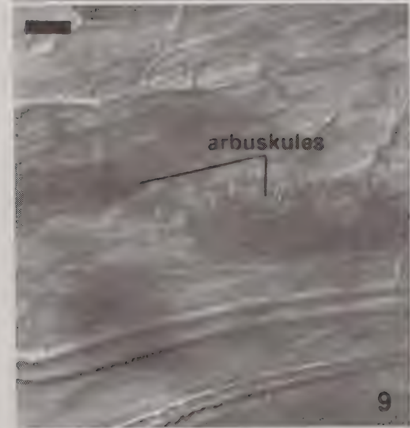
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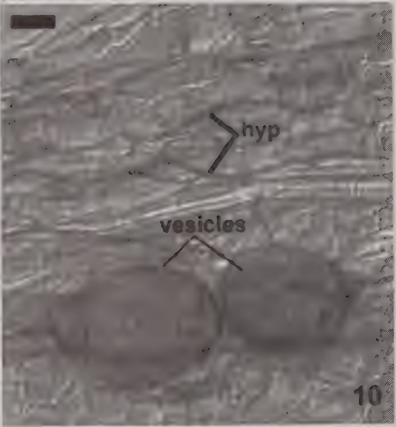
9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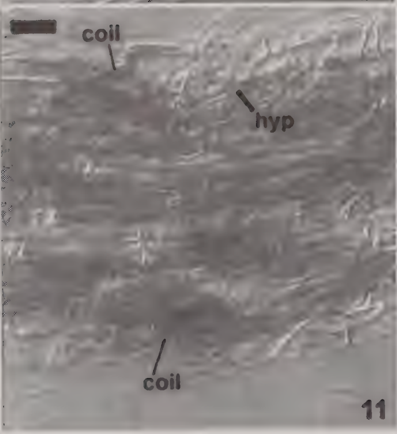
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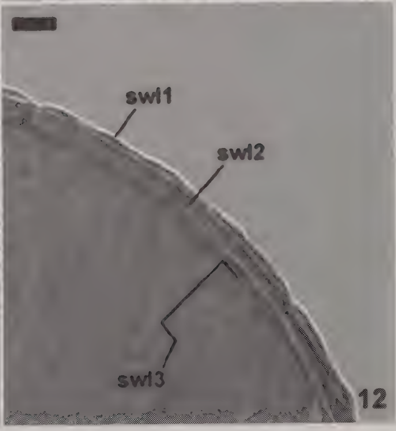
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12

Sporophore coenocytic to sparsely septate; hyaline to yellowish white (4A2); (2.2-)5.9(-8.4) μm wide; with a wall (0.4-)0.5(-0.7) μm thick; bearing spores by swelling at hyphal tips (Fig. 1). Most juvenile spores hyaline, with a one-layered wall, 0.8-1.2 μm thick. (Fig. 1). *Mature spores* yellowish-white (4A2) to golden-yellow (5B8); globose to subglobose; (110-)128(-155) μm diam; sometimes ovoid; 110-150 x 135-190 μm; with a single subtending hypha (Fig. 3).

Subcellular structure of spores consists of one wall (Figs. 4-8) with three layers (layers 1-3). Outermost layer 1 hyaline to orange-white (5A2), (0.7-)2.2(-4.6) μm thick, tightly adherent to layer 2 (Figs. 2, 4-8), ornamented with thickenings or blister-like outgrowths, 3.1-5.9 μm high, irregularly distributed on the spore surface (Figs. 4, 5); layer 1 sometimes either highly deteriorated or completely sloughed from separated patches of the surface of old spores (Figs. 7, 8). Layer 2 yellowish-white (4A2) to golden-yellow (5B8), smooth or slightly wrinkled, (0.7-)1.7(-2.0) μm thick, rigid, usually detached from layer 3 in crushed spores (Figs. 2, 4-8). Layer 3 laminate (Figs. 4-8), smooth, hyaline, composed of very thin laminae, *ca.* 0.5 μm thick, easily separating from each other in crushed spores (Figs. 6-8); (2.5-)7.7(-12.0) μm thick in intact spores, up to 15.7 μm thick after stratification of the laminae; darkening to golden yellow (5B8) and becoming compact in old spores (from 2-year-old cultures). Spore wall layers 1-3 form successively during the development of spores. None of the spore wall layers stains in Melzer's reagent.

Subtending hypha hyaline to yellowish white (4A2); straight or recurvate; cylindrical or funnel-shaped (Fig. 1), rarely constricted; (5.9-)7.6(-10.0) μm wide at the spore base. *Wall of subtending hypha* hyaline to yellowish white (4A2); (1.2-)1.8(-2.5) μm thick at the spore base; continuous with spore wall layers 1-3; layer 3 thinning for a distance of 4-10 μm below the spore base, and layer 1 is usually highly deteriorated or completely sloughed in older spores. *Pore* occluded by a septum, 1.7-5.6 μm wide, continuous with the innermost lamina of spore wall layer 3. Spore contents of oil droplets.

Collections examined. POLAND. Szczecin, under pot-cultured *P. lanceolata*, 10 Jan. 1999, *J. Błaszkowski, 2259-2270,* DPP.

Other materials examined. Spores from trap cultures established based on rhizosphere soils of *Corynephorus canescens* (L.) P. B. and *Helicotrichon umbellatum* (Hads.) Pilg. colonizing maritime dunes adjacent to Świnoujście (53°55'N, 14°14'E), *Błaszkowski, J., unnumbered collection* (DPP); U.S.A. California, San Miguel Island, spores from Professor R. E. Koske, University of Rhode Island, U. S. A., slide no. 2317.

Distribution and habitat. Spores of *G. trimurales* were recovered from three trap cultures established using soil samples collected from under *C. canescens* (2 cultures) and *H. umbellatum* (1 culture) colonizing maritime sand dunes adjacent to Świnoujście (53°55'N, 14°14'E) in northwestern Poland. However, in the dunes, *G. trimurales* sporulated only when associated with roots of *H. umbellatum* (at an abundance of two spores in 100 g dry soil), as examination of spores isolated from field-collected rhizosphere soils of the two plant species indicated. The arbuscular fungal species that had sporulated in the field samples from which *G. trimurales* was obtained in trap cultures were *G. corymbiforme* Błaszk., *G. fasciculatum* (Thaxter) Gerd. & Trappe emend. Walker & Koske, *G. macrocarpum* Tul. & Tul., *G. microcarpum* Tul. & Tul., an undescribed *Glomus* 111, and *Scutellospora persica* (Koske & Walker) Walker & Sanders. In the trap cultures, *G. trimurales* sporulated together with *Archaeospora trappei* (Ames & Linderman) Morton & Redecker, *G. lamellosum* Dalpé at al., and two undescribed *Glomus* spp.

The soil chemical properties of the Świnoujście dunes were: pH, 3.8-6.7; NO_3 (mg L^{-1}), 20-72; P, 5-12; K, 2-26; Mg, 10-41; Na, 4-23; Cl, 15-25; KCl, 0.1-0.6; organic C (%), 0.1-1.1 (Błaszkowski 1995).

Other records of the occurrence of *G. trimurales* in the world are only those from the U.S.A. (Koske 1987; Koske and Halvorson 1989; Koske, pers. comm.).

Mycorrhizal associations. In the Polish dunes, *G. trimurales* was associated with vesicular-arbuscular mycorrhizal roots of *C. canescens* and *H. umbellatum*. The mycorrhizae produced by this fungus in single-species pot cultures with *P. lanceolata* as the plant host consist of arbuscules, vesicles, as well as intra- and extramatrical hyphae. Arbuscules are numerous, evenly distributed along the roots and stain violet-white (17A2) to bluish-violet (18A7) in 0.1% trypan blue (Fig. 9). Vesicles are ellipsoid, 25-85 x 30-105 µm and stain pastel-violet (19A4) to greyish-violet (19C4) in trypan blue (Fig. 10). Intraradical hyphae (Figs. 9-11) grow parallel to each other and to the root axis, are 2.7-9.3 µm and stain violet white (18A2). The hyphae frequently form coils, especially at entry points (Fig. 11). The coils are 12.0-13.7 x 25.6-31.1 µm and stain pastel-violet (18A4; when separated from the entry points) to deep violet (18E8; at the entry points).

Discussion. The differentiation of spore wall of *G. trimurales* comprises successive formation of discrete layers, beginning from the outermost layer 1. This pattern corresponds with that found in all *Glomus* spp. investigated ontogenetically to date (e. g., Błaszkowski and Tadych 1997; Stürmer and Morton 1997). The most distinctive property of *G. trimurales* is its innermost hyaline, stratifying laminate layer 3 (Figs. 4-8). The yellowish-white to golden-yellow spore color of this fungus comes mainly from the permanent spore wall layer 2 (Figs. 4-8). The lack of parts of the outermost layer 1 on the surface of some mature spores (Figs. 7, 8) indicates this layer to be relatively long-lived, although it is not likely so permanent as an outermost layer of some other *Glomus* spp., e. g., *G. pustulatum* (Koske et al. 1986; pers. observ.).

The wall of subtending hypha of almost all the spores examined consists of only one layer continuous with the laminate spore wall layer 3. If present, the outermost layer and the middle layer of the subtending hyphal wall continuous with spore wall layers 1 and 2, respectively, are visible only very closely at the spore base.

The morphological properties of *G. trimurales* spores recovered from Poland generally correspond to those presented in the original description of this fungus (Koske and Halvorson 1989). The exceptions are only the properties of their outermost spore wall layer. Koske and Halvorson's (1989) description suggests that the outermost wall layer of *G. trimurales* spores is a pale yellow to yellow brown, smooth, persistent, laminate layer. In contrast, in spores coming from Poland, this layer is much lighter colored (colorless to orange white), ornamented with thickenings or blister outgrowths, more or less deteriorated in older spores; and lacks any sublayers (laminae). Color of wall layers of spores of arbuscular fungi varies with their age and usually is darker in spores produced in the field (Bentivenga and Morton 1995; Morton 1995). The original protocol of *G. trimurales* (Koske and Halvorson 1989) suggests it to be made from field-collected spores.

In the Polish specimens, the blisters are best visible when intact, i. e., usually only in maturing or mature spores (Figs. 2, 4-6). With age, they gradually diminish or completely disappear because of their degeneration and sloughing (Figs. 7, 8). The blisters were infrequently visible on spores isolated from the field. Examination of *G. trimurales* spores received from Professor R. E. Koske revealed them to have a roughened surface, and the ruggedness present are probably remnants of deteriorated blisters (Fig. 12). No sublayers in the outermost layer 1 of these spores were found. Finally, the laminae of the laminate innermost layer of some of the U. S. specimens of this fungus also are highly stratified, as in spores of this species coming from Poland. This distinctive property was not given by Koske and Halvorson (1989). Of the know *Glomus* spp., probably only *G. laccatum* Błaszk. produces spores with so easily stratifying sublayers of their laminate wall layer (Błaszkowski 1988).

The darkly staining vesicular-arbuscular mycorrhizae of *G. trimurales* for the first time presented in this paper (Figs. 9-11) supports the membership of this fungus to the genus *Glomus* (Morton and Redecker 2001).

When seen under a stereoscope microscope, spores of *G. trimurales* most resemble those of *G. pustulatum* and *G. versiforme* (Karsten) Berch. The three fungi produce spores similar in color and size, and the ornamentation of the surface of *G. trimurales* spores (Figs. 2, 4-6, 12) closely resembles that of *G. pustulatum* (Berch and Fortin 1983; Daniels and Trappe 1979; Koske et al. 1986).

Examination of spore wall structure readily separates the three fungi. The spore subcellular structure most markedly separating the fungi is their laminate layer. In *G. trimurales,* it is hyaline and easily stratifies due to its exceptionally loose sublayers (Figs. 4-8). In contrast, the laminate layer of *G. pustulatum* and *G. versiforme* consists of tightly adherent, colored laminae. Additionally, while the laminate layer in *G. trimurales* spores is the innermost layer in their 3-layered wall structure, that of *G. versiforme* is the second one in its 2-layered spores. The innermost layer of spores of *G. pustulatum* is a thin, flexible layer. Although the thickenings are outgrowths of the outermost layer of spores of *G. trimurales* and *G. pustulatum* are similar in appearance, size and distribution, they are formed by a hyaline to orange white layer in the former fungus (Fig. 9) and by a yellow brown to orange brown layer in the latter species. The outermost layer of *G. versiforme* spores quickly sloughs and is rarely present in mature specimens. Additionally, none of the species considered in this comparison possesses the colored, permanent layer 2 of *G. trimurales* spores.

Glomus trimurales probably is an extremely rarely occurring species in the world. In Poland, it was revealed in only three of the about 2500 soil samples examined to date. This fungal species was not found in any of the almost 900 pot trap cultures with rhizosphere soils of maritime dune plants growing in 21 countries of the world, including those of Africa, Asia, Europe, and U. S. A. (pers. observ.). According to Koske (1987), Koske and Halvorson (1989) and Koske (pers. comm.), *G. trimurales* occurred rarely in sand dunes of New Jersey, Maryland and Virginia, but was the third most frequently recorded species in dunes of San Miguel Island.

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We thank Professor R. E. Koske, Department of Biological Sciences, University of Rhode Island, USA and Doctor C. Walker, Biological Research and Imaging Laboratory, 2 Penny Hedge, New Milton, Hampshire, UK for providing specimens of *Glomus pustulatum* and *G. trimurales*, as well as *G. versiforme*, respectively, for examination. This study was supported in part by Committee of Scientific Researches, a grant no. 6.P04G.100.19.

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NON-POROID HYMENOCHAETACEAE (BASIDOMYCOTA) OF THE ATLANTIC RAIN FOREST IN NORTHEAST BRAZIL,

WITH A PRELIMINARY CHECK LIST OF BRAZILIAN SPECIES

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ABSTRACT: 29 species belonging to the genera *Clavariachaete*, *Dichochaete*, *Hydnochaete* and *Hymenochaete* have been found in Brazil. Eight species were found during a survey in the Atlantic Rain Forest in Northeast Brazil. Six of them are new records for this region.

KEY WORDS: *Clavariachaete*, *Dichochaete*, *Hydnochaete*, *Hymenochaete*

INTRODUCTION

The Atlantic Rain Forest of Brazil is a coastal ecosystem characterised by high biological diversity. Due to its location, it has suffered significant impact from colonisation and urbanisation which almost led to its complete destruction (Ministério do Meio Ambiente, dos Recursos Hídricos e da Amazônia Legal, 1998; Ranta et al., 1998).

There are few mycological studies of basidiomycetes in the Atlantic Rain Forest (Gugliotta, 1997; Loguércio-Leite & Gerber, 1997; Gugliotta & Bononi, 1999; Gerber & Loguércio-Leite, 2000; Góes-Neto et al., 2000) and only Soares & Gugliotta (1998) and Bononi (1979) refer to the non-poroid Hymenochaetaceae in this ecosystem.

The non-poroid Hymenochaetaceae are a group of the xanthocroic Basidiomycota characterised by a reddish or yellowish-brown context which darkens permanently with potassium hydroxide (Hawksworth et al., 1995). The basidioma can be resupinate, effused-reflexed, pileate sessile or stipitate, or clavarioid. Setae are usually found in the hymenium which can be smooth to tuberculate (Parmasto, 2001a).

This work aims to contribute with the knowledge of non-poroid Hymenochaetaceae in the Atlantic Rain Forest in Northeast Brazil and provide a preliminary checklist of these fungi from Brazil.

METHODS

During a two-year survey (September 2000 to June 2002) 13 reserves of the Atlantic Rain Forest in Northeast Brazil were visited. These reserves showed different degrees of conservation and were located in five (Sergipe, Alagoas, Pernambuco, Paraíba and Rio Grande do Norte) of the six states of Northeast Brazil which include this ecosystem.

State of Sergipe
1. Estação Ecológica Serra de Itabaiana (10°45'28''S and 37°18'55''W)
State of Alagoas
2. Reserva Particular do Patrimônio Natural (RPPN) Fazenda Rosa do Sol (9°50'24''S and 35°54'28''W)
3. RPPN Fazenda São Pedro (9°35'50''S and 35°57'24''W)
State of Pernambuco
4. Reserva Ecológica Dois Irmãos (8°15'30''S and 35°57'00''W)
5. Complexo de Gurjaú (8°28'66''S and 35°03'50''W)
6. Reserva Biológica Saltinho (8°42'00''S and 35°10'00''W)
7. Refúgio Ecológico Charles Darwin (7°50'03''S and 35°54'23''W)
State of Paraíba
8. Reserva Biológica Guaribas (6°50'19''S and 35°07'34''W)
9. RPPN Fazenda Pacatuba (7°05'47''S and 35°13'58''W)
10. RPPN Engenho Gargaú (7°06'50''S and 34°58'41''W)
11. Mata do Buraquinho (7°06'54''S and 34°51'47''W)
State of Rio Grande do Norte
12. RPPN Mata Estrela-Senador Antônio Farias (6°22'10''S and 35°00'28''W)
13. Floresta Nacional de Nísia Floresta (6°05'28''S and 35°12'31''W).

Collections, preparation of the material and microscopic and macroscopic analyses were made following the usual proceedings for these fungi (Maerz & Paul, 1950; Fidalgo & Bononi, 1989; Martin, 1934). All collections are deposited in O, TAA and URM. In the lists of collections, the localities are indicated with the numbers (1-13) as given above. All specimens were collected on dead hardwood or soil. E.P. – herbarium specimens studied by E. Parmasto.

RESULTS

During this survey aphyllophoraceous fungi were extensively collected. Of the 29 species found in Brazil, eight species of three genera of non-poroid Hymenochaetaceae were found in Northeast Brazil. All species except *Dichochaete setosa* and *Hymenochaete luteobadia* are new records from the region.

1. ***Dichochaete ceratophora*** (Job) Parmasto, Folia Cryptog. Estonica 37: 56, 2001
Syn.: *Hymenochaete ceratophora* Job, 1985; *H. alabastrina* Escobar ex Léger, 1990.
Distribution in Brazil: Rio Grande do Sul (Job, 1990; Azevedo & Guerrero, 1993); São Paulo (Escobar, 1978: 34; Léger, 1990: 295, 1998: 53; Léger, 1990; Soares & Gugliotta, 1998: 18). **New data**: **3**, November 2001 (URM77234), January 2002 (URM77235)

2. ***Dichochaete setosa*** (Sw.: Fr.) Parmasto, Folia Cryptog. Estonica 37: 57, 2001
Syn.: *Hymenochaete aspera* Berk & M. A. Curtis, 1868.
Distribution in Brazil: Pernambuco (Gibertoni, 1999: 30). **New data: 5**, July 2001 (URM77236); **6**, January 2002 (URM77237) and May 2002 (URM77238).

3. ***Hydnochaete peroxydata*** (Berk. ex Cooke) Dennis, Kew Bull. Add. Ser. 3: 105, 1970.
Syn.: *H. badia* Bres., 1896.
Distribution in Brazil: Bahia (E.P.); Rio de Janeiro (Ryvarden, 1982: 436; E.P.); Rio Grande do Sul (Ryvarden, 1982: 436; E.P.); Santa Catarina (Ryvarden, 1982: 436; E.P.); São Paulo (Soares & Gugliotta, 1998: 16; E.P.). **New data: 6**, May 2002 (URM77239).

4. ***Hymenochaete damicornis*** (Link) Lév., Ann. Sci. Nat. Bot. III 5: 151, 1846
Syn.: *H. formosa* Lév., 1846, *H. caxangaensis* Bat. & A.F. Vital, 1960.
Distribution in Brazil: Acre (Escobar, 1978: 62; E.P.); Amazonas (Escobar, 1978: 62; E.P.); Mato Grosso (E.P.); Pernambuco (Batista & Vital, 1960: 363; Job, 1990: 18); Rio Grande do Sul (Rick, 1930: 398; Escobar, 1978: 62; Job, 1985: 229, 232; Azevedo & Guerrero, 1993: 154; E.P.); Roraima (Escobar, 1978: 62); Santa Catarina (Escobar, 1978: 62); São Paulo (Escobar, 1978: 86; Bononi, 1979: 88; Job, 1985: 231, 232, 1990: 18; Soares & Gugliotta, 1998: 24; Léger 1998: 115; E.P.). **New data: 1**, January 2002 (URM77244); **3**, May 2002 (URM77247); **4**, May 2002 (URM77240); **5**, March 2002 (URM77243); **6**, March 2002 (URM77246); **8**, July 2002 (URM77242); **10**, May 2001 (URM77241); **11**, March 2002 (URM77245).

5. ***Hymenochaete leonina*** Berk & M.A. Curtis, J. Linn. Soc. Bot. 10 (46): 334, 1868
Distribution in Brazil: Amazonas (Escobar, 1978: 119; Léger 1998: 176; E.P.); Rio Garnde do Sul (Escobar, 1978: 119; Job, 1985: 229, 233, 1990: 25); Rondônia (Escobar, 1978: 119; Léger 1998: 176); Roraima (E.P.); São Paulo (Escobar, 1978: 119; E.P.). **New data: 3**, October 2000 (URM77260), July 2001 (URM77261), November 2001 (URM77262), January 2002 (URM77296), March 2002 (URM77263); **4**, November 2001 (URM77248) and March 2002 (URM77249); **6**, May 2002 (URM77266); **7**, September 2000 (TAA184558), November 2001 (URM77256), January 2002 (URM77257), March 2002 (URM77258) and May (URM77259); **8**, November 2001 (URM77253), January 2002 (URM77254) and March 2002 (URM77255); **10**, November 2001 (URM77250), March 2001 (URM77251) and May 2002 (URM77252); **12**, November 2000 (URM77264).

6. ***Hymenochaete luteobadia*** (Fr.) Höhn. & Litsch., K. Akad. Wiss. Wien Sitzsungsber. 116: 750, 1907

Syn.: *H. kunzei* (Hook.) Massee, 1890.

Distribution in Brazil: Amazonas (Escobar, 1978: 128); Bahia (E.P.); Ceará (Escobar, 1978: 128); Mato Grosso (E.P.); Pará (Léger, 1998: 187); Pernambuco (Gibertoni, 1999: 31); Rio de Janeiro (Escobar, 1978: 128; Léger 1998: 187; E.P.); Rio Grande do Sul (Job, 1985: 233, 1990: 28); Rondônia (Escobar, 1978: 128); Roraima (Escobar, 1978: 128; E.P.); São Paulo (Bononi, 1979: 88; E.P.). **New data: 1**, January 2002 (URM77286); **2**, March 2001 (URM77287); **3**, October 2000 (URM77289); **4**, March 2001 (URM77267), May 2001 (URM77268), July 2001 (URM77269), September 2001 (URM77270); March 2002 (URM77271) and July 2002 (URM77272); **5**, May 2002 (URM77278); **6**, July 2001 (URM77288); **8**, July 2001 (URM77276) and November 2001 (URM77277); **10**, July 2001 (URM77273) and November 2001 (URM77274 and URM77275); **11**, November 2001 (URM77279), January 2002 (URM77280) and March 2002 (URM77281); **13**, November 2001 (URM77282 and URM77283), March 2002 (URM77284) and May 2002 (URM77285).

7. *Hymenochaete pinnatifida* Burt, Ann. Missouri Bot. Gard. 5: 355, 1918

Distribution in Brazil: Amazonas (E.P.); Rio Grande do Sul (Job, 1985: 228, 230, 234; 1990: 32; Azevedo & Guerrero, 1993: 157); São Paulo (Escobar, 1978: 153). **New data: 4**, May 2001 (URM77290); **5**, July 2001 (URM77292); **6**, July 2001 (URM77293); **10**, May 2001 (URM77291).

8. *Hymenochaete rheicolor* (Mont.) Lév., Ann. Sci. Nat. Bot. III 5: 151, 1846

Syn.: *H. sallei* Berk. & M.A. Curtis, 1868; *H. tenuissima* Berk., 1847.

Distribution in Brazil: Bahia (E.P.); Espírito Santo (Escobar, 1978: 184); Rio de Janeiro (Rick, 1930: 397, 398; Escobar, 1978: 183; Job, 1985: 230, 1990: 37; Azevedo & Guerrero, 1993: 160; E.P.); Rio Grande do Sul (Escobar, 1978: 183; Job, 1985: 230, 231, 1990: 37); Rondônia (Escobar, 1978: 183); Santa Catarina (Escobar, 1978: 183); São Paulo (Teixeira, 1946; Escobar, 1978: 183, 184; Bononi, 1979: 88 as *H. berkeleyana;* Job, 1990: 37; E.P.); Santa Catarina (E.P.). **New data: 5**, November 2001 (URM77294).

PRELIMINARY CHECK LIST OF NON-POROID HYMENOCHAETACEAE IN BRAZIL

The states where the species have been found are indicated after the name. Only literature sources of those authors who have studied specimens of the species are indicated.

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D. setosa (Sw.: Fr.) Parmasto, 2001b.

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Hymenochaete aberrans G.A. Escobar ex Léger, Cryptogamie, Mycol. 11 (4): 292. 1990 – São Paulo (Escobar, 1978: 30; Léger, 1990: 293, 1998: 41).

H. americana Gresl. & Parmasto, Folia Cryptog. Estonica 37: 59. 2001. – Rio Grande do Sul (Parmasto, 2001b: 135).

H. anomala Burt, Ann. Missouri Bot. Gard. 5: 358. 1918 (syn.: *H. weldenii* G.A. Escobar, 1978) – Rio Grande do Sul (Job, 1985: 228, 229, 232, 233); São Paulo (Léger, 1998: 301; E.P.).

H. cervina Berk. & M.A. Curtis, J. Linn. Soc. Bot. 10: 334. 1868 (syn.: *H. corticolor* Berk. & Ravenel, 1873) – Minas Gerais (Job, 1990: 16); Pará (Escobar, 1978: 72); Rio Grande do Sul (Job, 1985: 228, 229, 231, 232, 233, 1990: 12; E.P.); Santa Catarina (E.P); São Paulo (Escobar, 1978: 54; Léger, 1998: 88).

H. cinnamomea (Pers.: Fr.) Bres., I. R. Acad. Agiati Atti III 3: 110. 1897 – Mato Grosso (E.P.); São Paulo (Escobar, 1978: 58; Job, 1990: 13; Soares & Gugliotta, 1998: 18).

H. contiformis G. Cunn., Trans. Roy. Soc. New Zeal. 85 (1): 41. 1957 – Rio Grande do Sul (Escobar, 1978: 62; Job, 1990: 14).

H. damicornis (Link) Lév., 1846.

H. dura Berk. & M.A. Curtis, J. Linn. Soc. Bot. 10: 334. 1868 – Rio Grande do Sul (Job, 1990: 21; E.P.; BPI 278854, leg. J. Rick 1932 is a dubious specimen – E.P.).

H. epichlora (Berk. & M.A. Curtis) Cooke, Grevillea 8: 147. 1880 – Rio Grande do Sul (Job, 1985: 229, 1990: 21).

H. globispora Escobar ex Léger, Cryptogamie, Mycol. 11: 300. 1990. – Minas Gerais (E.P.).

H. leonina Berk. & M.A. Curtis, 1868.

H. luteobadia (Fr.) Höhn. & Litsch., 1907.

H. minuscula G. Cunn., Trans. Roy. Soc. New Zeal. 85 (1): 48. 1957 – Rio Grande do Sul (Job, 1985: 230; Azevedo & Guerrero, 1993: 155); São Paulo (Escobar, 1978: 137; Job, 1990: 29).

H. pinnatifida Burt, 1918.

H. pratensis Viégas, Bragantia 5 (4): 261. 1945 –Rio Grande do Sul (Job, 1985: 230, 233, 1990: 34); São Paulo (Viégas, 1945: 261; Léger 1998: 225).

H. raunkiaeri Bres., Ann. Mycol. 18: 45. 1920. – São Paulo (E.P.).

H. reniformis (Fr.) Lév., Ann. Sci. Nat. Bot. III 5: 151. 1846 (syn.: *Stipitochaete reniformis* (Fr.) Ryvarden, 1985) – Acre (Ryvarden, 1985: 539); Mato Grosso (Ryvarden, 1985: 539); São Paulo (Escobar, 1978: 158; Léger 1998: 232; Soares & Gugliotta, 1998: 25).

H. rhabarbarina (Berk.) Cooke, Grevillea 8: 148. 1880. – Rio Grande do Sul (Azevedo & Guerrero, 1993: 158; E.P.); São Paulo (Escobar, 1978: 163).

H. rheicolor (Mont.) Lév., 1868.

H. rigidula Berk. & M.A. Curtis, J. Linn. Soc. Not. 10: 334. 1868 – Rio Grande do Sul (Escobar, 1978: 169; Job, 1985: 228, 229, 233, 1990: 38).

H. tabacina (Sowerby: Fr.) Lév., Ann. Sci. Nat. Bot. III 5: 152. 1846 (syn.: *H. crocata* (Sowerby: Fr.) Lév., 1846) – Rio Grande do Sul (Job, 1985: 229, 232; E.P.); not mentioned by Escobar (1978) or Job (1990); only literature data indicated by Léger (1998: 278); specimen in the Rick's Fungi Austro-Americani 264 is misidentified – E.P.). Brazilian specimens are mostly somewhat atypical.

H. tenuis Peck, Rep. N. Y. St. Mus. 40: 57. 1887 (syn.: *H. multisetae* Burt, 1918) – Rio Grande do Sul (Job, 1985: 229, 1990: 44); São Paulo (Escobar 1978: 141).

H. unicolor Berk. & M.A. Curtis, J. Linn. Soc. Bot. 10: 335. 1868 – Santa Catarina (Burt, 1918: 342; Escobar, 1978: 203; Job, 1990: 45); Rio Grande do Sul (Job, 1985: 231); São Paulo (Bononi, 1979: 87).

H. ustulata Escobar ex Léger, Cryptogamie, Mycol. 11 (4): 309. 1990 – Rio Grande do Sul (Job, 1985: 232, 233, 1990: 46); São Paulo (Léger, 1990: 310; 1998: 286).

H. vallata G. Cunn., Trans. Roy. Soc. New Zeal. 85 (1): 46. 1957 – São Paulo (Escobar, 1978: 210; Job, 1990: 47).

Dubious data

H. adusta (Lév.) Har. & Pat., J. Bot. (Morot) 17: 7. 1903 (syn.: *H. cacao* (Berk.) Berk., 1868): Pernambuco (Job, 1990); São Paulo (Bononi 1979: 89). A species very similar to *H. luteobadia;* no correctly identified specimens from South America have been seen – E.P.

H. attenuata (Lév.) Lév., Ann. Sci. Nat. Bot. III 5: 152. 1846 – São Paulo (Job, 1985: 231; mentioned with some doubt and not indicated any more in Job, 1990).

H. corrugata (Fr.: Fr.) Lév., Ann. Sci. Nat. Bot. III 5: 152. 1846 – one specimen of this species has been found among the collections by J. Rick under the name *H. spreta* Peck and another among unidentified specimens in Rio Grande do Sul (Job, 1985: 230, 233); a specimen from Rio Grande do Sul in BPI, no. 150018 (Rick, Oct. 1931) is a species of *Stereum* (E.P.); São Paulo (Soares & Gugliotta, 1998: 18). A species misunderstood by several mycologists; E.P. has not seen any correctly identified specimens of this species from Brazil.

H. proxima Rick, Broteria 3: 37. 1934 – Rio Grande do Sul (Rick, 1934, 1937; Job, 1990: 35). – Only the type of this species is known; possibly identical with *H. pratense.*

H. rubiginosa (Dicks.: Fr.) Lév., Ann. Sci. Nat. Bot. III 5: 151. 1846 – Rio Grande do Sul (Job, 1985: 233, 234); not mentioned for Brazil in Job (1990).

H. tuberculosa Cooke, Grevillea 9: 101. 1881 – Rio de Janeiro (Léger 1998: 281: possibly a synonym of *H. leonina*).

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DISTRIBUTION OF GEASTRUM SPECIES FROM SOME PRIORITY REGIONS FOR CONSERVATION OF BIODIVERSITY OF SONORA, MEXICO

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ABSTRACT

With the purpose of contributing to the knowledge of the taxonomy and ecology of the species of *Geastrum*, three priority regions for conservation of biodiversity from Sonora, Mexico were sampled. The survey was conducted during the four seasons of the year in six vegetation types. Sampling localities were characterized by biotic and abiotic factors based upon topographic and subject charts as well as physical and chemical soil analyses. Seventeen species of *Geastrum* were determined, six are reported for the first time from Sonora, *G.pouzarii* and *G. pseudolimbatum* being new records for the Mexican mycobiota. The highest number of specimens were collected in tropical thorn forest and tropical deciduous forest. Although gastrocarps of *Geastrum* were observed throughout the year, they were more commonly found during summer and autumn.

Key words: taxonomy, chorology, Gasteromycetes, Geastraceae

INTRODUCTION

Actually, Mexico is considered the fourth most biodiverse country in the world, although the mycobiota of some states such as Sonora, rich in mushroom species, is poorly known. This depends on several factors, the most important being the little attention paid to this biotic resource, as well as the great extension of the state and the diversification of habitats and microhabitats present in such a large area. Among the diverse macromycetes of Sonora, the best known group belongs to the Gasteromycetes, which are well represented in the prevailing arid and semiarid regions of the state. From aproximately 200 taxa of Gasteromycetes reported for Mexico, about 100 are known in Sonora; of these, Lycoperdaceae have the highest number of taxa with 35 (Esqueda *et al*., 1996, 1998). Within this family, the genus *Geastrum* is outstanding because some species, such as *G. kotlabae, G. striatum* and *G. xerophilum* are little known in Mexico. Based on the priority regions for conservation of biodiversity in Mexico, established by the Comisión Nacional para el Conocimiento y Uso de la Biodiversidad (CONABIO), a taxonomic, ecologic and chorologic study of the species of *Geastrum* occurring in three priority regions of Sonora was realized.

MATERIALS AND METHODS

The study was carried out in three priority regions for conservation in Sonora: San Javier-Tepoca (Region I), Punta de Cirio (Region II) and Sierra de Álamos (Region III), sampling in each season of the year during 1995-1998 in six vegetation types. The 20 studied localities were geo-referencied employing a Magellan GPS ProMark X (Magellan System Corp., San Dimas, CA) (Table 1). The taxonomy of *Geastrum* species was done according to Sunhede (1989). The specimens were collected and prepared following the traditional mycological techniques. The structures of the gleba of most of the species were observed under a scanning electron microscope Jeol, JSM-5200. The samples were studied after a treatment in an equipment Polaron E-2000 during 60 seconds at 1.2 Kv and 20 mA in an argon atmosphere to obtain a gold cover of 500 Å.

The specimens are kept in the macromycetes collection of the Centro de Estudios Superiores del Estado de Sonora (CESUES) with some duplicates in the Herbario Nacional (MEXU). Sampling places were characterized by biotic and abiotic factors based upon topographic and subjet charts, and physical and chemical soil analyses. The soil analysis was made on the base of ten samples (approximately 4 kg) taken at random in each locality at a depth of 0-30 cm. The determinations were made by triplicate. Samples were tested for texture, gravel proportion, pH, organic matter, salinity, nitrates, phosphates, electric conductivity.

Table 1. Sampling localities of some priority regions for the conservation of biodiversity from Sonora, Mexico.

Localities	Vegetation	N	W
Region I			
Municipality of La Colorada			
Km 100 Hermosillo to Yécora road	TTF	28°37´11´´	110°07´09´´
Municipality of San Javier			
Km 137.5 Hermosillo to Yécora road	TDF	28°34´34´´	109°46´42´´
Km 151 Hermosillo to Yécora road	TDF	28°34´33´´	109°40´55´´
Km 4 to San Javier road	OF	28°34´58´´	109°44´48´´
Municipality of Soyopa			
Km 162.5 Hermosillo to Yécora road	TTF	28°33´45´´	109°35´58´´
Km 172 Hermosillo to Yécora road	TTF	28°34´18´´	109°33´11´´
Municipality of Ónavas			
Km 200.5 Hermosillo to Yécora road	POF	28°28´29´´	109°29´05´´
Km 204.5 Hermosillo to Yécora road	OPF	28°27´45´´	109°18´41´´
Region II			
Municipality of Hermosillo			
Montículo de Rocas	MDS	29°42´54´´	112°26´06´´
Ejido 15 de Mayo	MDS	29°47´31´´	112°31´55´´
Punta de Cirio ranch	MDS	29°49´14´´	112°34´15´´
Las Dunas	MDS	29°52´45´´	112°38´14´´
Region III			
Municipality of Álamos			
Km 42 Navojoa to Álamos road	TDF	27°04´05´´	109°01´28´´
Km 7.5 Álamos to Guirocoba way	TDF	26°57´14´´	108°56´11´´
Km 12.3 Álamos to Guirocoba way	TDF	26°56´34´´	108°52´59´´
Las Uvalamas ranch	TDF	26°57´42´´	108°55´30´´
La Sierrita ranch	TDF	26°58´27´´	108°56´40´´
El Aguaje	TDF	26°57´58´´	108°57´28´´
Nucleus of Sierra de Álamos	TDF	26°57´35´´	108°57´43´´
El Encinal	TDF	26°58´10´´	108°59´00´´

Vegetation type: MDS (Microphyllous Desert Scrub); TTF (Tropical Thorn Forest); TDF (Tropical Deciduous Forest); OF (Oak Forest); OPF (Oak-Pine Forest); POF (Pine-Oak Forest).

RESULTS AND DISCUSSION

Taxonomy, ecology and chorology. Seventeen *Geastrum* species were determined (Table 2), six are reported for the first time for Sonora; *G. pouzarii* and *G. pseudolimbatum* are new records for Mexico. Most of the

Table 2. Distribution of *Geastrum* species.

	Geastraceae (Basidiomycotina: Gasteromycetes)																											
	Region I																				Region II				Region III			
***Geastrum* species**	**TTF**				**TDF**				**OF**				**POF**				**OPF**				**MDS**				**TDF**			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
G. campestre Morg.																											◆	◆
G. corollinum (Batsch) Hollós	◆	◆				◆																			◆	◆	◆	◆
*G. *coronatum* Pers.																						◆						
*G. *fimbriatum* Fr.		◆				◆																			◆			◆
*G. *floriforme* Vitt.		◆		◆		◆						◆						◆			◆	◆		◆		◆	◆	◆
*G. *fornicatum*(Huds.) Hooker		◆																										
G. kotlabae Stanek				◆																								
G. lageniforme Vitt.																		◆								◆	◆	
G. minimum Schw.		◆		◆			◆															◆					◆	◆
G. pectinatum Pers.:Pers.			◆															◆										
**G. *pouzarii* Stanek	◆						◆																	◆				◆
**G. *pseudolimbatum* Hollós	◆			◆						◆																		
G. quadrifidum Pers.:Pers.		◆																◆										
G. saccatum Fr.		◆	◆			◆		◆							◆			◆				◆				◆	◆	◆
G. striatum De Candolle		◆	◆				◆																		◆		◆	
G. triplex Jungh.																										◆	◆	
G. xerophilum (Long) P. Ponce de León																								◆				

Vegetation: MDS (Microphyllous Desert Scrub); TTF (Tropical Thorn Forest); TDF (Tropical Deciduous Forest); OF (Oak Forest); OPF (Oak-Pine Forest); POF (Pine-Oak Forest). **Season**: 1 (Spring); 2 (Summer); 3 (Autumn); 4 (Winter).* New records from Sonora. ** New records for the Mexican mycobiota.

specimens occur in tropical thorn forest and tropical deciduous forest. The taxa considered are present throughout the year. However, most grow during the summer and autumn and even by winter in tropical deciduous forest. *Geastrum floriforme* and *G. saccatum* were some of the species most frequently found in the locations under study. In Mexico, *G. saccatum* is most commonly collected in the autumn all in tropical forest regions and in coniferous forests. In oak and pine-oak forests, the fruitbodies were scarce. Several species such as *G. fimbriatum, G. saccatum* and *G. triplex* are widely spread in Mexico. Nevertheless, most of the species have a limited habitat and fructification period like *G. fornicatum* and *G. xerophilum,* agreeing with previous reports for Mexico (Pérez-Silva *et al.,* 1999).

In Mexico, *G. corollinum* was only known from Baja California, where it occurs during the summer and autumn in chaparral vegetation (Ochoa, 1993), while in Sonora it grows in tropical thorn forest in spring and summer, and throughout the year in tropical deciduous forest. The gleba of this species is used in Himalayan folk medicine for otorrhoea, earache, wounds, umbilical sepsis and burns, showing an improvement or cure in almost all cases (Joshi *et al.*, 1982). It is similar to *G. floriforme*, which is different due to its delimited peristome and smaller spores. *G. fimbriatum* generally grows in conifer forests with *Abies, Picea,* and *Pinus* species, growing from July to mid-December (Herrera, 1957; Sunhede, 1989; Pérez-Silva *et al.*, 1999). In Sonora, it was collected in tropical thorn forest in summer and throughout the year, except in the autumn, in tropical deciduous forest (Table 2). In Europe and in the Peninsula of Baja California *G. floriforme* has been found growing in sandy soils with a good nutrient content. In Europe it grows in the autumn, while in Baja California and Sonora it occurs in late winter through the middle of spring.

The distribution of *G. kotlabae*, reported as *G. drummondii* from Mexico and Sonora (Guzmán & Herrera, 1969), is now extended. *Geastrum lageniforme* was collected in the summer showing a gregarious habit, growing on soils rich in decomposing wood in oak-pine forest and in the summer and autumn in tropical deciduous forest. The reports from Mexico (Pérez-Silva *et al.,* 1999) and Europe (Sunhede, 1989) regarding vegetation and fructification period are the same. *G. minimum* was initially considered to grow in typically xerophilous basic soils (Demoulin, 1968; Guzmán & Herrera, 1969). It was later reported from acid soils (Calonge, 1981) and in chaparral with *Adenostoma, Euphorbia* and *Quercus* (Ochoa, 1993) where it grows during spring and winter. It was found in microphyllous desert scrub, tropical thorn forest and tropical deciduous forest in Sonora, growing along the year except in the spring (Table 2). *Geastrum pectinatum* was collected in the autumn in tropical thorn forest and in the summer in oak-pine woodland of epithermal soils. It has also been found in the Sonoran desert in the autumn (Aparicio *et al.,* 1994; Pérez-Silva *et al.,*1999).

Geastrum pouzarii was collected in microphyllous desert scrub, tropical thorn forest and tropical deciduous forest. This species is close to *G. campestre* from which it differs by its smaller spores, less warty endoperidium and very small to smaller fruitbodies. *Geastrum pseudolimbatum* was found in tropical thorn forest in spring and winter and in oak forest in summer (Table 2). Fresh specimens are found in Europe from June to November usually right next to *Quercus* spp. (Sunhede, 1989). *Geastrum coronatum* is similar to the previous taxon, differing only in its smaller fruitbody, hygroscopic rays, whitish stalk and spore ornamentation. *Geastrum pectinatum* differs from the previous species by smaller fruitbody, shorter stalk, columella morphology and spore ornamentation. Regarding taxonomy of *G. pouzarii* and *G. pseudolimbatum,* Calonge (1998) doubts about their position as independent taxa, classifying them as a variety and a form of other species: *G. campestre* var. *pouzarii* (Stanek) Calonge, and *G. coronatum* f. *pseudolimbatum* (Hollós) Dörfelt & Müller-Uri.

Geastrum striatum presents a distribution limited to tropical thorn forest and tropical deciduous forest, where it grows throughout the year except in the winter. It has been collected from Baja California Sur (Ochoa, 1993), Morelos and Sonora (Esqueda *et al.,* 1995; Pérez- Silva *et al.,*1999) in microphyllous desert scrub, ecotone tropical deciduous forest and oak forest in autumn and winter.

Calcium oxalate crystals have been reported in several *Geastrum* species such as *G.campestre, G. pectinatum* and *G. striatum,* but crystals are not obligatory in these species, a fact which led to various taxonomic confusions. They are always found on the endoperidium as a product of the pseudoparenchymatic layer of the exoperidium. In *Geastrum*, crystals seem to function not only in the absorption of excess oxalic acid, but also as a decontaminating agent for excess calcium (Krisai & Mrazek, 1986). Once exposed to the environment, the crystals are altered, undergoing some combination of erosion, dissolution, and recrystallization. Rainfall is likely the most important factor in the modification of crystal morphology, since the pH of rain is typically below 7.0, calcium oxalate being soluble in acidic solutions (Whitney & Arnott, 1986).

Physical and chemical soil analyses. The soil saturation varied from 26% in the arid zones up to 48% in the tropical deciduous forest (Table 3). This variability reflected the differences among localities, considering texture,

Table 3. Physical and chemical soil analyses.

Soil Factors	**Region I** San Javier-Tepoca		**Region II** Punta Cirio		**Region III** Álamos	
	TTF	**TDF**	**OPF**	**POF**	**MDS**	**TDF**
% Saturation	26-41	28-48	35-41	41-50	27-30	26-47
PH	7.4-8.2	5.2-5.8	4.4-4.6	4.5-7.4	8.0-8.3	6.0-6.9
Electric conductivity (mmhos/cm)	0.31-1.14	0.34-1.20	0.31-0.49	0.31-0.42	0.50-0.94	0.20-0.36
Ca + Mg (Meq/L)	2.0-10.5	2.0-11.0	2.1-2.9	0.7-2.5	4.0-8.0	1.5-3.5
Na (Meq/L)	0.9-1.1	1.0-1.4	1.6-2.4	1.5-1.7	1.0-1.8	0.1-0.5
Sodium absorption ratio	0.39-1.10	0.43-1.40	1.41-2.15	1.52-2.55	0.70-1.27	0.04-0.58
% Interchangeable sodium	0.08-0.15	0.09-0.30	0.35-0.45	0.36-0.42	0.08-0.61	0.07-0.19
% Sand	69.1-83.2	77.1-84.7	55.4-67.0	59.5-71.1	79.3-89.8	63.6-88.4
% Limestone	11.6-24.0	8.0-10.3	19.5-22.7	18.4-21.6	8.1-14.5	8.3-20.3
% Clay	5.0-6.8	7.2-12.5	13.4-21.6	10.5-18.7	1.98-6.16	2.1-16.3
% Gravel	26-39	52-61	50-53	53-59	53-55	29-38
NO_3^- (mg/kg)	2.5-9.3	2.5-18.1	1.1-2.3	1.9-3.1	0.2-3.1	1.2-4.3
$PO_4^{=}$ (mg/kg)	3.5-13.5	13.5-26.2	3.6-4.8	2.9-4.1	0.2-23.1	6.5-19.2
Total organic matter	2.0-6.0	3.0-9.0	4.2-7.6	5.3-8.3	2.0-2.5	2.5-12.0

Vegetation: MDS (Microphyllous Desert Scrub); TTF (Tropical Thorn Forest); TDF (Tropical Deciduous Forest); OPF (Oak-Pine Forest); POF (Pine-Oak Forest).

organic matter and gravel proportion. The pH changed from acid to basic. The highest value (8.3) was observed in microphyllous desert scrub and the lowest (4.4) in oak-pine forest with epithermal soil. Rimóczi (1995) observed a pH range from 4.8 to 7.8 for several species of *Geastrum* collected in Hungary. As to electric conductivity, all the samples had values lower to 1.2 mmhos/cm. Considering that a soil with salinity problems presents values higher than 4 mmhos/cm, no locality was found with soluble salts in excess (Castellanos *et al.*, 2000). The values of Ca + Mg Meq/lt, Na Meq/lt and sodium absorption ratio are necessary to establish the percent value of interchangeable sodium, which was lower than 0.62 in all the cases. There is no problem in the sodium concentration which should be higher than 15% to produce harmful accumulation of this element. In the same way there was no critical concentration of $CaCO_3$ in any of the analyzed samples which could inhibit the absorption of phosphates or nutrients such as iron, zinc and manganese, among others.

In relation to the texture, all the localities had heavy soils less than 20% of total clay and more than 50% of sand. The percentage of gravel was very variable even in the same locality. In general it was high for all localities (more than 20% is considered high). As result of that, the soil has the tendency to be more deficient in nutrients, can reach higher temperatures and the retention of moisture is lower.

The variation in the NO_3^- content was of 0.2 to 18.1 mg/kg. In the woodland regions the concentration was of a low to medium level, while in the tropical forest localities it was high (Castellanos *et al.*, 2000). For the species of *Geastrum* collected in Hungary, Rimóczi (1995) found a wider range in the NO_3^- content of 1.0 to 148 mg/kg, which could be the result of the large number of analyzed samples with emphasis in specific areas. The $PO_4^{\equiv}$ content changed from low to high. The lower concentrations were found in pine-oak and oak-pine forests with epithermal soils of 2.9-4.8 mg/kg (Table 3). The highest concentration was observed in tropical deciduous forest in the priority region of San Javier-Tepoca (26.2). In most of the samples the content was from medium to medium high. Rimóczi (1995) found variation from 10 to 1584 mg/kg of P_2O_5 in soils where *G. coronatum, G. fimbriatum, G. fornicatum, G. striatum* occur in Hungary.

The percentage of organic matter ranged from 2.0 to 12%. The lower concentration was in tropical thorn forest and microphyllous desert scrub; and the highest in tropical deciduous forest of the priority region of Sierra de Álamos (Table 3). These levels go from poor soil to very rich in organic matter content. In the soils of Hungary, the percentage of humus where the species of *Geastrum* grow varies from 1.0 to 43.3.

The results of diverse researches on the influence of the edaphic factors in the behavior of macromycetes with emphasis in mycorrhizal species have been very variable and contradictory. Cifuentes *et al.* (1997) point out that the patterns of distribution are highly influenced by the type of soil and the altitudinal and climatic conditions rather than the type of vegetation or geographic vicinity. When Bujakiewicz (1992) studied seven types of deciduous forest communities in central Europe, it was observed that macromycetes usually have a wide ecologic spectrum owed principally to specific requirements in a combination of climatic and edaphic factors.

Description of the new records for Mexico

Geastrum pouzarii Stanek, Ces. Mykol. 8: 100-107, 1954.
Gastrocarp 8-21 mm wide when expanded. Exoperidium hygroscopic, 7-9 rays. Mycelial layer encrusting debris, peeling off at expansion. Fibrous layer black brown, smooth to cracked. Fleshy layer whitish to beige. Endoperidial body 4-8 mm diam., globose to subglobose, brown whitish; stalk about 0.4-.0.8 mm high, whitish. Peristome conical, plicate, with 13-16 folds, ± well delimited. Mature gleba dark brown. Columella light beige, short-columnar.
Spore 5-6.5 µm diam., yellow brown, globose to subglobose, with an oil drop, warty under OM; under SEM episporium show columnar processes up to 0.4-0.6 µm high, which may be ± confluent; with broad intercolumnar regions. Capillitial hyphae 3-5 µm wide, brown yellowish, not branched, not septate, not pitted, thick-walled, with continuous to lacunar lumen, and surface smooth or with debris.
Habit and habitat. Gregarious, terrestrial, in microphyllous desert scrub, tropical thorn forest and tropical deciduous forest. Fruitbodies found throughout the year except in the summer.
Specimens examined. Municipality of San Javier, Km 137 Hermosillo to Yécora road, *leg.* M. Esqueda, A. Armenta, A. Núñez & R. Santos, 24.XI.1995 (CESUES 2344). Municipality of Hermosillo, Las Dunas, *leg.* M. Esqueda, A. Armenta, A. Núñez, R. Santos & A. Sánchez, 23.I.1998 (CESUES 3743). Municipality of Álamos, Km 7.5 Álamos to Guirocoba way, *leg.* M. Esqueda, A. Armenta, A. Núñez, R. Santos & A. Sánchez, 14.II.1998 (CESUES 3898). Municipality of La Colorada, Km 100 Hermosillo to Yécora road, *leg.* M. Esqueda, A. Armenta, A. Núñez, R. Santos & A. Sánchez, 14.IV.1998 (CESUES 3975).

Remarks. *G. pouzarii* is similar to *Geastrum campestre,* but mycelial layer easily peels off at expansion, endoperidial surface is weakly warted or almost mealy and has smaller spores. It grows in Europe (Germany and Spain) and Asia, fruiting from February through July on thin soil layer with basic pH, rarely acid soils; generally on slopes of valleys of rivers or creeks and in open areas with xerophilous vegetation (Sunhede, 1989).

Geastrum pseudolimbatum Hollós, Math. Termész. Ertes. 19: 507-508, 1901 (as *Geaster*).

Fruitbodies 15-38 mm wide when expanded. Rays ± hygroscopic, some fornicate, mostly 6-11. Mycelial layer some persistent, encrusted with debris; pseudoparenchymatous layer pale to dark brownish, smooth to cracked, fibrous layer whitish to light beige. Endoperidial body globose to depressed globose, diameter 8-13 mm, brown greyish. Stalk 1-2 mm high, flattened, whitish. Peristome conical, fibrillose, indistinctly delimited. Mature gleba dark brown. Columella light beige, short, subspheric.

Spores 5-6.5 µm diam., brown yellowish, globose to subglobose, with an oil drop, rugose or warty under OM; SEM-picture show up to 0.5 µm high columnar processes which sometimes are confluent, apiculus with radiating ridge-like processes. Capillitial hyphae 4-6 µm wide, brown yellowish, not branched, not septate, not pitted, thick-walled, continuous to lacunose lumen, smooth or with surface debris.

Habit and habitat. Gregarious, terrestrial, in tropical thorn forest, *Quercus* forest and *Quercus, Juniperus* and *Pinus* woodland. Fruitbodies growing throughout the year except in the autumn.

Specimens examined. Municipality of La Colorada, Km 100 Hermosillo to Yécora road, *leg.* A. Armenta, A. Núñez & R. Santos, 16.II.1996 (CESUES 2364); 08.VI.1996 (CESUES 2774). Municipality of Yécora, 3.2 km Yécora to Sahuaripa way, *leg.* M. Esqueda, 01.VII.1997 (CESUES 3287; MEXU 24544). Municipality of San Javier, Km 4 to San Javier road, *leg.* A. Armenta, A. Núñez & R. Santos, 25.VIII.1998 (CESUES 4243).

Remarks. *G. pseudolimbatum* is close to *G. coronatum*, but the former presents a smaller basidioma, rays truly hygroscopic, whitish stalk, episporium with columnar processes, more or less confluent with ridges at the base. It is known from northern of Europe and Asia where it grows from June through November generally under the shadow of *Quercus* spp. (Sunhede, 1989).

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A PRELIMINARY SURVEY OF MARINE FUNGI FROM CUBA

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Abstract: A preliminary survey of the Cuban marine fungi was undertaken. Twenty six marine fungi are reported from 12 beaches located on the Atlantic Coast, of which, 19 (16 ascomycetes and 3 mitosporic fungi) are new for this country. This brings the total number of known higher marine fungi for Cuba to 29.

Keywords: Ascomycota, arenicolous fungi, biodiversity, Caribbean Islands, mitosporic fungi, mycobiota

Resumen: Se realizó un estudio preliminar de los hongos marinos de Cuba. En este trabajo se reportan 26 hongos marinos de 12 playas localizadas en la costa del Atlántico, de los cuales, 19 (16 ascomycetes y 3 hongos mitospóricos) son nuevos para este país. Con estos nuevos registros, el número total de hongos marinos superiores reportados para Cuba es de 29.

INTRODUCTION

The number of fungal species worldwide is thought to be not fewer than 1.5 M, of which 80 060 have been described (Hawksworth 1991, 2001, Kirk et al. 2001). Of these, most have been studied in northern temperate regions. In general, the fungi of the tropics remain poorly documented, especially in Africa and South America. The diversity of fungi from Cuba remains unknown in large part. In this country there are probably 70 000 species of fungi, but only 3 870 have been recorded (Minter 2001). With reference to higher marine fungi, worldwide, over 444 species have been described (Hyde et al. 2000). In comparison, the diversity of Cuban higher marine fungi is little known, with only 29 species recorded. The first collection of higher marine fungi in this country was made by Hariot and Patouillard (1904), who reported the species *Zignoella cubensis* on *Halopteris scoparia* (≡*Stypocaulon scoparium*, Phaeophyta) in Havana Bay on the Gulf of Mexico Coast. Subsequent interest in marine fungi, however, was only sporadic. Meyers (1957) described *Halosphaeria quadricornuta* (≡*Antennospora quadricornuta*) and *Lulworthia* sp. (=*Lulworthia floridana*) from Guantanamo Bay. Later, Kohlmeyer (1975) transferred the genus *Zignoella* to the new genus *Pontogeneia* and included the species *Pontogeneia cubensis* (≡*Zignoella cubensis*). Capó de Paz (1986) recorded 19 species from Viriato Beach (Institute of Oceanology

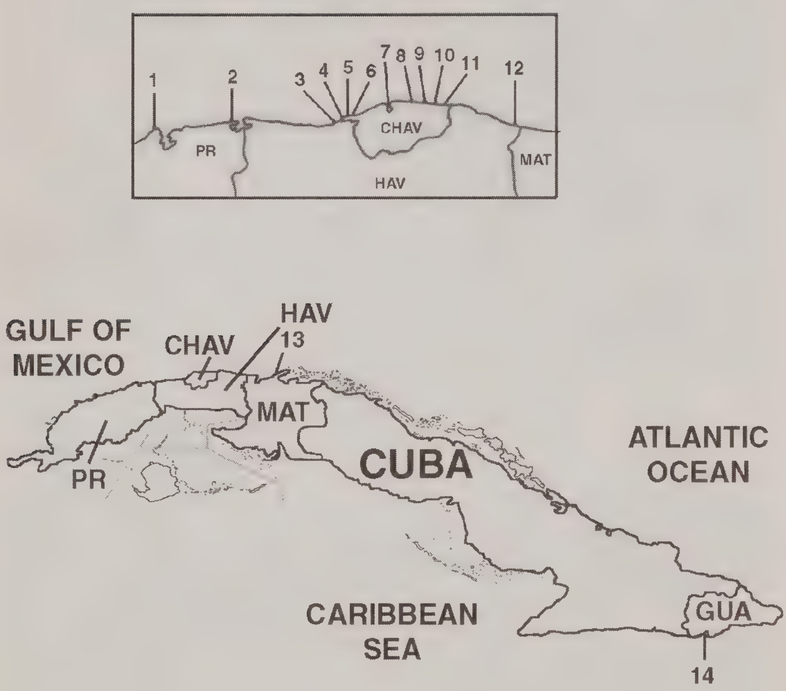
Bay), 17 of which were new records from Cuba. Unfortunately, those records cannot be verified because specimens were not preserved and deposited in a recognized collection, and therefore, they are not included in this paper. Nevertheless, an ongoing research project on higher marine fungi was initiated in this country by Enríquez and González (2000). This work contributes to knowledge of coastal biodiversity of Cuba and it will serve as the basis for further studies.

MATERIALS AND METHODS

Subtidal wood or washed-up detritus (wood pieces, algae and other debris) was collected from 12 Cuban beaches, covered with moist sand from the collecting sites, and incubated in sterile hermetic plastic bags for 4-12 mo. The fungi were examined on natural substrates and then made into permanent slides according to the double cover glass method (Volkmann-Kohlmeyer and Kohlmeyer 1996). Specimens are deposited as slides and/or dried material in the fungal collection (CHM) of Collection of Marine Microorganisms of the Institute of Oceanology in Havana, Cuba. The records of the species of new collections were merged with the records of all the species published. Annotations on species examined are given only for the 19 new records, and these are marked with an asterisk. Each locality has been given a number referring to the list of localities (Table 1), and to the map (Fig. 1). Species are listed alphabetically according to their major groups with information on collecting sites and substrates. The updated names of marine fungi are taken from Hyde et al. (2000).

Table 1. New collection sites and collecting locations from the literature, dates, and Provinces of Cuba. In some geographic localities the information of collecting date is incomplete due to the lack of data in the published literature. Abbreviations were used for each collecting site. The location numbers refer to the Fig. 1.

GULF OF MEXICO	
1. LCP	Las Cuarenta, 22° 59' 69" N, 83° 12' 40" W, May. 2001, Pinar del Río.
2. HEP	La Herradura, 22° 90' 60" N, 83° 01' 40" W, May. 2001, Pinar del Río.
3. BAL	Baracoa, 23° 02' 84 " N, 82° 34" 34"' W, Jun. 2001, La Habana.
4. ESL	El Salado, 23° 02' 38" N, 82° 32' 08" W, May. 2001, La Habana.
5. SFH	Santa Fé, 23° 05' 00" N, 82° 30' 54" W, Jun. 2001, Mar. 2000, Ciudad La Habana.
6. VIH	Viriato (Institute of Oceanology Bay), 23° 05' 55" N, 82° 28' 30" W, Sep. 2001, Mar. 2000, Ciudad La Habana.
7. HAH	La Habana Bay, 23° 10' 58" N, 82° 15' 43" W, Ciudad La Habana.
8. BAH	Bacuranao, 23° 10' 58" N, 82° 14' 43" W, Nov. 2000, Ciudad La Habana.
9. SMH	Santa María, 23° 10' 62" N, 82° 11' 24" W, Mar. 2000, Ciudad La Habana.
10. BCH	Boca Ciega, 23° 10' 46" N, 82° 09' 97" W, Nov. 2000, Ciudad La Habana.
11. BMH	Brisas del Mar, 23° 10' 48" N, 82° 06' 02" W, Nov. 2000, Ciudad La Habana.
12. JIL	Jibacoa, 23° 08' 83" N, 81° 51' 51" W, Nov. 2000, La Habana.
13. VAM	Varadero, 23° 08' 61" N, 81° 16' 56" W, Jun. 2000, Matanzas.
CARIBBEAN OCEAN	
14. GUG	Guantánamo Bay, 19° 55' 00" N, 75° 10' 00" W, Guantánamo.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CUBA
ATLANTIC OCEAN
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CARIBBEAN SEA
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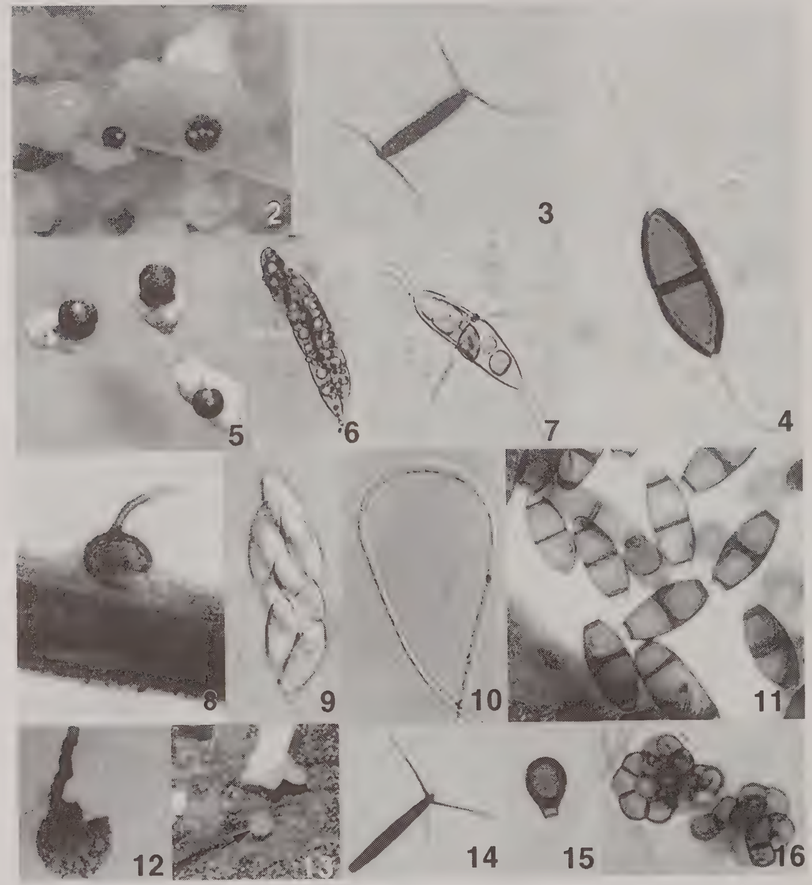
Fig. 1. Map of Cuba showing localities of the Provinces of Cuba in which marine fungi were recorded. See list of localities, Table 1. Province of City of Havana = CHAV, Province Havana = HAV, Province Guantánamo = GUA, Province Matanzas = MAT, Province Pinar del Río = PR. Each locality has been given a number referring to the list of localities (Table 1).

RESULTS

Twenty six fungi were recorded from 12 Cuban beaches, and of these, 19 species are new records for Cuba. *Corollospora maritima*, and *Arenariomyces parvulus* are the most widely distributed. Concerning the mitosporic fungi, *Varicosporina ramulosa*, was most frequently found. The new collections were incorporated with the records from the literature, resulting in a total of 29 taxa (25 ascomycetes and 4 mitosporic fungi) from 14 different locations in Cuba. The province most studied in the country was the Province City of Havana on the Gulf of Mexico Coast.



Figs. 2-16. Marine fungi from Cuba.
2. Ascomata of *Arenariomyces parvulus* x 25. 3. Ascospore of *A. parvulus* x 800. 4. Ascospore of *Corollospora cinnamomea* x 1000. 5. Ascomata of *Corollospora maritima* x 17. 6. Ascus of *C. maritima* x 260. 7. Ascospore of *C. maritima* x 660. 8. Ascoma of *Lignincola tropica* x 30. 9. Ascus of *L. tropica* x 1 280. 10. Ascospore of *Lindra thalassiae* x 240. 11. Ascospores of *Savoryella lignicola* x 400. 12. Ascoma and ascospores of *Lulworthia grandispora* x 35. 13. Immature ascoma of *Torpedospora radiata* x 15. 14. Ascopore of *T. radiata* x 400. 15. Conidiospore of *Trichocladium alopallonellum* x 450. 16. Conidiospores of *Zalerium varium* x 1000.

Figs. 3, 14. Ascospores stained with gentian violet.

ASCOMYCOTA

Antennospora quadricornuta (Cribb et J. W. Cribb) T. W. Johnson, J. Elisha Mitchell Sci. Soc. 74: 46, 1958.
ESL, driftwood, CHM 0126; BAH, driftwood, CHM 0110, detritus CHM 0110.
Cuban records: GUG, driftwood (Meyers 1957).

****Arenariomyces parvulus*** W. J. Koch, Nordic J. Bot. 6: 497, 1986.
LCP, *Thalassia testudinum*, CHM 140; HEP, detritus, CHM 0130; BAL, leaves, *Cocoloba uvifera*, CHM 0116, leaves, *Rhizophora mangle*, CHM 0119, leaves, *Thalassia testudinum*, CHM 0120; ESL, detritus, CHM 141; BAH, intertidal wood, CHM 0109; JIL, *Casuarina equisetifetea*, CHM 142.
Cuban records: BAH, foraminiferan tests of *Archaias angulatus* and *Amphistegina gibbosa* (Enríquez et al. 2001).

****Arenariomyces trifurcatus*** Höhnk, Veroeff. Inst. Meeresforsch. Bremerhaven 3: 30, 1954.
SMH, wood, CHM 143; BCH, intertidal wood, CHM 0018.

Arenariomyces triseptatus Kohlm., Mar. Ecol. (P.S.Z.N.I.) 5: 333, 1984.
BAL, fronds, *Sargassum* sp., CHM 144; VAM, leaves, *Cocoloba uvifera*, CHM 0064, leaves, *Thalassia testudinum*, CHM 0071, foraminiferan shells, CHM 0101.
Cuban records: SFH, detritus; SMH, *Dictyota* sp., (Enríquez and González 2000); VAM, foraminiferan test of *Rosalina rosea* (Enríquez et al. 2001).

Ceriosporopsis halima Linder, Farlowia 1: 409, 1944.
Cuban records: SMH, detritus, CHM 145 (Enríquez and González 2000).

****Corollospora armoricana*** Kohlm. and Volkm.-Kohlm., Can. J. Bot. 67: 1281, 1989.
HEP, wood, CHM 147; VIH, leaves, *Rhizophora mangle*, CHM 0089; BAH, leaves, *Rhizophora mangle*, CHM 0104; BMH, *Halodule whitte*, CHM 0008; BCH, leaves, *Rhizophora mangle*, CHM 0014.

****Corollospora cinnamomea*** Jørgen Koch. Nordic J. Bot. 6: 498, 1986.
LCP, leaves, *Thalassia testudinum*, CHM 0134.

Corollospora gracilis Nakagiri et Tokura, Trans. Mycol. Soc. Japan 28: 426, 1987.
BAH, leaves, *Thalassia testudinum*, CHM 0105; BCH, leaves, *Thalassia testudinum*, CHM 0023; BMH, fronds, *Sargassum*, CHM 0002; JIL, fronds, *Sargassum* sp., CHM 0086; VAM, fronds, *Sargassum* sp., CHM 0054, leaves, *Thalassia testudinum*, CHM 0037.
Cuban records: SFH, leaves, *Thalassia testudinum* SMH; fronds, *Sargassum* sp. (Enríquez and González 2000).

Corollospora maritima Werderm., Notizbl. Bot. Gart. Berlin 8: 248, 1922.
LCP, leaves, *Thalassia testudinum* CHM 0138; HEP, driftwood, CHM 0129; BCH, leaves, *Rhizophora mangle*, CHM 0025, seed, *Cocos nucifera*, CHM 0028; BAH, leaves, *Thalassia testudinum*, CHM 0106; BAH, leaves, *Thalassia testudinum*, CHM 0106; JIL, leaf, *Cocoloba uvifera*, CHM 0075, leaves, *Thalassia testudinum*, CHM 0079, fronds, *Sargassum* sp., CHM 0083; BMH, leaves, *Thalassia testudinum*, CHM 0001, fronds, *Sargassum* sp., CHM 0003, driftwood, CHM 0017; JIL, leaf, *Cocoloba uvifera*, CHM 0075, leaves, *Thalassia testudinum*, CHM 0079,

fronds, *Sargassum* sp., CHM 0083; VAM, leaves, *Thalassia testudinum*, CHM 0048, fronds, *Sargassum* sp., CHM 0055, seed, *Cocos nucifera*, CHM 0066, leaf, *Cocoloba uvifera*, CHM 0060. **Cuban records:** SFH, seed, *Cocos nucifera*; VIH, driftwood; SMH, leaves, *Rhizophora mangle*, leaves, *Thalassia testudinum, Dictyota* sp., CHM 0042; VIH, leaves, *Thalassia testudinum*, seed, *Cocos nucifera*, CHM 0094 (Enríquez and González 2000); VAM, foraminiferan tests of *Rosalina rosea, Discorbis mira, Archaias angulatus*(Enríquez et al. 2001).

****Corollospora pseudopulchella*** Nakagiri et Tokura, Trans. Mycol. Soc. Japan 28: 428, 1987.
BCH, driftwood, CHM 0019; BMH, leaves, *Thalassia testudinum*, CHM 0009.

****Corollospora quinqueseptata*** Nakagiri, Trans. Mycol. Soc. Japan 28: 430, 1987.
HEP, leaves, *Thalassia testudinum*, CHM 149; BAH, leaves, *Thalassia testudinum*, CHM 0114.

****Falcatispora cincinnatula*** (Shearer et J.L. Crane) K.L. Pang et E. B. G. Jones
LCP, wood, CHM; SFH, intermareal wood, CHM 0039.

****Lignincola leavis*** Höhnk, Veroeff. Inst. Meeresforsch. Bremerhaven 3: 216, 1955.
BAL, driftwood, CHM 0117; ESL, leaves, *Thalassia testudinum*, CHM 0125; BCH, seed, *Cocos nucifera*, CHM 0029.

****Lignincola tropica*** Kohlm. Mar. Ecol. (P.S.Z.N.I.) 5: 355, 1984.
VIH, driftwood, CHM 0092; SMH, seed, *Rhizophora mangle*, CHM 0031; BCH, *Gorgonia* sp., CHM 0021.

****Lindra marinera*** Meyers, Mycologia 61: 488, 1969.
BCH, driftwood, CHM 0020; SMH, *Dictyota* sp., CHM 0041; BMH, fronds, *Sargassum* sp., CHM 0004; JIL, *Halodule whitte*, CHM 0073, fronds, *Sargassum* sp., CHM 0074, CHM 0081.
Cuban records: SFH, fronds, *Sargassum* sp. (Enríquez and González 2000); VIH, foraminiferan tests of (Enríquez et al. 2001).

****Lindra obtusa*** Nakagiri et Tubaki, Mycologia 75: 488, 1983.
BAH, leaves, *Thalassia testudinum*, CHM 0115.

****Lindra thalassiae*** Orpurt, Meyers, Boral et Simms, Bull. Mar. Sci. Gulf Caribb. 14: 406, 1964.
All ascomata on dead leaves, *Thalassia testudinum*: LCP, CHM 0139; SMH, CHM 0034; BMH, CHM 0007; JIL, CHM 0082; VAM, CHM 0049.

****Lulworthia grandispora*** Meyers, Mycologia 49: 513, 1957.
LCP, leaves, *Thalassia testudinum*, CHM 0135; HEP, *Rhizophora mangle*, CHM 149; BAL, *Reynosia revoluta*, CHM 0118, leaves, *Thalassia testudinum*, CHM 0121; ESL, leaves, *Cocoloba uvifera*, CHM 0124; SFH, *seed of Cocos nucifera*, CHM 150; BAH, *Reynosia revoluta*, CHM 0108; SMH, leaves, *Cocoloba uvifera*, CHM 0032; BCH, seed of *Cocos nucifera*, CHM 0013, leaves, *Rhizophora mangle*, CHM 0015; VAM, driftwood, CHM 0051.

****Lulworthia kniepii*** Kohlm., Nova Hedwigia 6: 140-141, 1963.
LCP, detritus, CHM 151; BAH, *Reynosia revoluta*, CHM 0107, leaves, *Thalassia testudinum*, CHM 0112.

Lulworthia fucicola G. K. Sutherl., Trans. Br. Mycol. Soc. 5: 259, 1916.
BAH, leaves, *Rhizophora mangle*, CHM 0111.

Lulworthia sp.
Cuban records: GUG, driftwood (Meyers 1957).

Neptunella longirostris (Cribb et J. W. Cribb) K. L. Pang et E. B. G. Jones
ESL, seed, *Cocos nucifera*, CHM 0123.

Pontogeneia cubensis (Har. et Pat.) Kohlm., Bot. Jahrb. 96: 207, 1975.
Cuban records: BAH, *Stypocaulon scoparium*, (Kohlmeyer 1975).

Savoryella lignicola E. B. J. Jones et R. A. Eaton, Trans. Br. Mycol. Soc. 52: 162, 1969.
LCP, intermareal wood, CHM 0131.

Torpedospora radiata Meyers, Mycologia 49: 496, 1957.
LCP, leaves, *Thalassia testudinum*, CHM 0137; HEP, *Rhizophora mangle*, CHM 152; BAL, wood, CHM 153; BAH, leaves, *Rhizophora mangle*, CHM 0103; BCH, seed, *Cocos nucifera*, CHM 0027; JIL, *Cocoloba uvifera*, CHM 0076.
Cuban records: SFH, seed, *Cocos nucifera* (Enríquez and González 2000).

MITOSPORIC FUNGI

Cirrenalia basiminuta Raghuk. et Zainal, Mycotaxon 31: 163, 1988.
VAM, fronds, *Sargassum* sp., CHM 0053.

Trichocladium alopallonellum (Meyers et R. T. Moore) Kohlm. et Volkm.-Kohlm. Mycotaxon 53: 352, 1995.
LCP, intertidal wood,CHM 0132; BCH, leaves, *Rhizophora mangle*, CHM 0024; VAM, wood, CHM 158.

Varicosporina ramulosa Meyers et Kohlm., Can. J. Bot. 43: 916, 1965.
VIH, leaves, *Thalassia testudinum*, CHM 159; SMH, leaves, *Thalassia testudinum*, CHM 0038; JIL, leaves, *Thalassia testudinum*, CHM 0078; VAM, leaves, *Thalassia testudinum*, CHM 0050, *Cocoloba uvifera*, CHM 0061.
Cuban records: SFH, detritus, CHM 0102 (Enríquez and González 2000)

Zalerion varium Anastasiou, Can. J. Bot. 41: 1136, 1963.
JIL, *Cocoloba uvifera*, CHM 0077; ESL, seed, *Cocos nucifera*, CHM 0122.

DISCUSSION

This study contributes to our knowledge of the geographical distribution and occurrence of marine species from Cuba. Although in Cuba the distribution of the marine mycobiota has not been studied as in other tropical countries such as Belize (Kohlmeyer and Volkmann-Kohlmeyer 1987a), the Galapagos (Kohlmeyer and Volkmann-Kohlmeyer 1987b), the Hawaiian Islands (Kohlmeyer and Volkmann-Kohlmeyer 1989, Volkmann-Kohlmeyer and Kohlmeyer 1993), Malaysia (Jones and Kuthubutheen 1990, Sundari et al. 1996), Mexico (González et al. 2001), and Virgin Islands (Kohlmeyer and Volkmann-Kohlmeyer 1988), it appears that the biodiversity is high, based on the number of collections made and the results obtained in this work. *Pontogeneia cubensis* was the first new species described from a Cuban location. Of twenty six species registered in this study, *Lindra thalassiae*, *Lulworthia grandispora*, and *Varicosporina ramulosa* were previously found by Capó de Paz (1986). Many species recorded in this work are arenicolous (*Arenariomyces parvulus*, *A. trifurcatus*, *A. triseptatus*, *Corollospora cinnamomea*, *C. maritima*, *C. pulchella*, *C. quinqueseptata*) and this is in agreement with the environment where the samples were tacken (Volkmann-Kohlmeyer and Kohlmeyer 1993). Several of the fungi collected in this work are cosmopolitan species: *Arenariomyces trifurcatus*, *Corollospora maritima*, *C. pulchella*, *Lignincola laevis* (Kohlmeyer and Kohlmeyer 1979). Although *Halosphaeriopsis mediosetigera*, and its anamorphic state, *Trichocladium achrasporum*, is one of the most frequently collected marine fungus, this species was absent in Cuban collections. Most of the records of *H. mediosetigera* are from temperate waters, whereas its anamorph is frequently found from tropical waters (Kohlmeyer 1984, Nakagiri and Tubaki, 1985). Because this species was absent does not necessarily mean that it does not occur in the island, and it may show up in future collections. *Arenariomyces triseptatus* and *Corollospora cinnamomea* are tropical fungi, having been recorded in Mexico (Kohlmeyer 1984), Thailand (Koch 1986), and Puerto Rico (Kohlmeyer and Volkmann-Kohlmeyer 1987c), and those species were found in Cuba. *Arenariomyces trifurcatus* and *C. maritima* are the most frequent species in the Caribbean (Volkmann-Kohlmeyer and Kohlmeyer 1993). The most widely distributed species from the Cuban beaches studied was *C. maritima*. All species collected are saprobes living on washed-up algae, sea grass leaves, and parts of other angiosperms. Several species obtained are lignicolous (*Antennospora quadricornuta, Ceriosporopsis halima, Lignincola laevis, Lulworthia grandispora, Savoryella lignicola, Torpedospora radiata, Trichocladium alopallonellum*) (Hyde 1986, Jones 1976). In general, it appears that the marine fungi of Cuba do not differ essentially from those of other tropical regions. The marine fungal biota of the Cuban archipelago formed by the Island of Cuba, the Isle of Youth, and around 4 195 keys and small islands, is unknown for the most part. For that reason, it is necessary to continue studying the mycobiota of the marine coasts to contribute to the conservation and knowledge of the diversity of microfungi from Cuba.

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SOME NEW SPECIES AND NEW RECORDS OF DISCOMYCETES IN CHINA. XI*

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Abstract: Three new species and a new variety of *Lachnum* on dicotyledon leaves and bamboo are described. Name changes for a few previously recorded discomycetes and a new combination of *Lachnum* are made.

Key words: Taxonomy, *Hymenoscyphus*, *Lachnum*, *Sarcoscypha*

NEW TAXA

Lachnum culmicola W.Y. Zhuang, **sp. nov.** 秆生粒毛盘菌 (Figs. 1–4)

Ab *Lachno stipulicola* differt apotheciis grandis, 0.8–1.4 mm diam.; pilis subcapitatis apicaliter; ascis longioribus, 86–94 × 5–5.6 µm; paraphysibus lanceolatis, 3–5 µm latis; ascosporis (10–)12–17 × 1.7–2 µm.

Apothecia discoid, 0.8–1.4 mm in diam, stipitate; hymenium surface pure white when fresh, receptacle surface white, hairy; hairs cylindrical, enlarged apically, granulate, hyaline, thin-walled, 27–150 µm long, 2–3 µm wide below and enlarged to 5–7 µm at apex (excluding granules); ectal excipulum of textura prismatica, 16–30 µm thick, cells hyaline, thin-walled, 8–18 × 3–6 µm; medullary excipulum of textura intricata, 35–65 µm thick, hyphae hyaline, 1–2.5 µm wide; subhymenium poorly developed; hymenium 105–112 µm thick; asci cylindric-clavate, 8-spored, pore J+ in Melzer's reagent, 86–94 × 5–5.6 µm; ascospores fusoid, nonseptate, occasionally with one septum, multiguttulate, irregularly biseriate, (10–)12–17 × 1.7–2 µm; paraphyses lanceolate, 3–5 µm at the widest, exceeding the asci by 6–20 µm.

Holotype: China. Hunan: Yizhang County, Mangshan Nature Reserve, alt. 1200 m, on dead branchlets of a small bamboo, 13-IV-2002, W.Y. Zhuang & Y.H. Zhang 4164, HMAS 82151.

Notes: Among the bambusicolous species of *Lachnum*, *L. culmicola* is very similar to *L. stipulicola* in ascospore characteristics but different significantly from the latter in the larger apothecia (0.8–1.4 mm vs. 0.2–0.3 mm in diam.), hairs enlarged apically instead of tapered toward apex and lacking of amorphous substance at tips, longer asci (86–94 × 5–5.6 µm vs. 39–50 × 3.9–5.5 µm), wider paraphyses (3–5 µm vs. 2–2.8 µm at the widest) exceeding the asci by 6–20 µm instead of up to 10 µm, and occurrence on branchlets of a small bamboo instead of on sheathing stipules of a large bamboo (Haines, 1992).

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Lachnum hyalopus (Cook & Massee) Spooner var. **sinobambusae** W.Y. Zhuang, **var. nov.** 禾本科粒毛盘菌竹变种 (Fig. 5)

Ab *Lachno hyalopo* var. *hyalopo* differt apotheciis magnis, 1–2 mm diam., ascis longioribus et angustioribus, 90–110 × 5.5–6.7 µm; ascosporis 32–52 × 1.2–1.8 µm; paraphysibus lanceolatis, ascos superantibus (0–5 µm); bambusicolis.

Apothecia discoid, 1–2 mm in diam, long-stipitate; hymenium surface pure white when fresh, receptacle surface white, hairy; hairs cylindrical, granulate, hyaline, thin-walled, 45–95 µm long, 3.5–4.5 µm wide below and enlarged to 5–6.5 µm at apex (excluding granules); ectal excipulum two-layered, outer layer of textura prismatica, ca 30 µm thick, cells hyaline, thin-walled, 5–18 × 3–11.5 µm, inner layer of textura porrecta, 10–30 µm thick; medullary excipulum of loose textura intricata, 50–190 µm thick, hyphae hyaline, 1–2 µm wide; subhymenium poorly developed; hymenium 110–125 µm thick; asci cylindric-clavate, 8-spored, pore J+ in Melzer's reagent, 90–110 × 5.5–6.7 µm; ascospores cylindrical with the lower end slightly narrowed, 1–3-septate, lying parallel in a single fascicle within the ascus, spores filling the upper 40–50% of the ascus, 32–52 × 1.2–1.8 µm; paraphyses narrowly lanceolate to lanceolate with a pointed apex, 2–4 µm at the widest, exceeding the asci by 0–5 µm.

Holotype: China. Hunan: Yizhang County, Mangshan Nature Reserve, alt. 1200 m, on dead culms of a small bamboo, 15-IV-2002, W.Y. Zhuang & Y.H. Zhang 4314, HMAS 82152. Paratype: *ibid.*, W.Y. Zhuang & Y.H. Zhang 4294, HMAS 82153.

Notes: The fungus is very similar to *Lachnum hyalopus* on leaves of *Phormium* sp. (Agavaceae) from New Zealand in shapes of apothecia, asci, ascospores, and paraphyses. It differs from the latter in larger (1–2 mm vs. 0.4–1 mm in diam.) and pure white instead of pale orange apothecia, slightly longer and narrower asci (90–110 × 5.5–6.7 µm vs. 85–95 × 7.5–8.5 µm), paraphyses exceeding the asci very slightly instead of up to 20 µm, and on dead culms of a small bamboo instead of *Phormium* leaves (Spooner, 1987). It is also similar to *Lachnum cylindricum* W.Y. Zhuang & K.D. Hyde on bamboo in the 3-septate ascospores (Zhuang & Hyde, 2001) but different obviously in the long-stipitate and larger apothecia (1–2 mm vs. 0.4–0.7 mm in diam.), much narrower asci (5.5–6.7 µm vs. 7.5–10.5 µm wide), narrower ascospores (1.2–1.8 µm vs. 2–3 µm wide), and wider paraphyses (2–4 µm vs. 2 µm at the widest).

Lachnum mangshanense W.Y. Zhuang, **sp. nov.** 莽山粒毛盘菌 (Figs. 6–7)

Ab *Lachno haematino* differt pilis hyalinis, longis, 32–280 × 2.5–4 µm; ascis parvis, 30–32 × 3.5–4.3 µm; ascosporis 9–11(–12) × 0.9–1.2 µm.

Apothecia discoid, 0.6–1 mm in diam, long-stipitate, stipes ca 1 mm long when dry; hymenium surface light yellow when dry, receptacle surface white, with very long and delicate hairs; hairs cylindrical, granulate, hyaline, thin-walled, the shortest at margin and longest at flanks and on stipe, 32–280 × 2.5–4 μm (excluding granules); ectal excipulum of two layers, outer layer of textura prismatica, 10–20 μm thick, cells hyaline, thin-walled, 7–20 × 3–6.5 μm, inner layer of textura porrecta, ca 10 μm thick; medullary excipulum of loosely textura intricata, 30–75 μm thick, hyphae hyaline, 1.5–3.5 μm wide; subhymenium poorly developed; hymenium ca 45–47 μm thick; asci clavate, 8-spored, pore J+ in Melzer's reagent, 30–32 × 3.5–4.3 μm; ascospores narrowly fusoid, with several very tiny guttules, 9–11(–12) × 0.9–1.2 μm; paraphyses narrowly lanceolate to subcylindrical with a blunt apex, 1.5–2 μm at the widest, exceeding the asci by 3–5 μm.

Holotype: China. Hunan: Yizhang County, Mangshan Nature Reserve, alt. 1200 m, on rotten leaves of a broadleaf tree, 15-IV-2002, W.Y. Zhuang & Y.H. Zhang 4315, HMAS 82154.

Notes: The closest species of *Lachnum* Retz. to *L. mangshanense* is *L. haematinum* J.H. Haines (Haines, 1992). They are similar in long-stipitate apothecia, narrowly fusoid ascospores, narrowly lanceolate paraphyses very slightly exceeding the asci, and in being leaf-inhabiting. The former is distinguishable from the latter in much longer hairs (32–280 × 2.5–4 μm *vs*. 60–120 × 4–5 μm) which are hyaline and lack of any water soluble reddish-brown coating masses on tips, two-layered ectal excipulum of thin-walled textura prismatica to textura porrecta instead of textura oblita blending to thick-walled textura prismatica near the apothecial margin, and shorter asci (30–32 × 3.5–4.3 μm *vs*. 35–45 × 2.5–4 μm). *Lachnum mangshanense* is also similar to *L. hainanese* W.Y. Zhuang & Zheng Wang on rotten leaves of dicotyledon tree but differs in much longer hairs (32–280 × 2.5–4 μm *vs*. 40–76 × 2.5–3.5 μm), 2-layered ectal excipulum, shorter ascospores [9–11(–12) × 0.9–1.2 μm vs. 11.5–14 × 1–1.5 μm], ascus pores J+ instead of J– in Melzer's reagent, and slightly narrower paraphyses with a blunt apex instead of a pointed one (Zhuang & Wang, 1998). They should be separated at species level.

Lachnum willisiopsis W.Y. Zhuang, **sp. nov.** 拟威氏粒毛盘菌 (Figs. 8–10)

Ab *Lachno willisii* differt apotheciis magnis, 1.5 mm diam., longe stipitatis; cellulis excipuli magnis, 10–21 × 5–20 μm; ascis longis, 47–55 × 3.5–4 μm; paraphysibus latioribs, 4–6 μm latis.

Apothecia discoid, up to 1.5 mm in diam, long-stipitate, stipes ca 2–2.5 times the apothecial diameter; hymenium surface beige to cream colored, receptacle surface cinnamon brown due to the color of hairs; hairs brown to light brown, granulate, thin-walled, with 1–2 septa, shortest at apothecial base, 23–70 × 2.5–5 μm (excluding granules); ectal excipulum of textura angularis to textura prismatica near the stipe, of 1–2 cell layers, 18–28 μm thick, cells subhyaline, 10–21 × 5–20 μm; medullary excipulum of textura intricata, 25–115 μm thick, hyphae hyaline, 1–3.5 μm wide; subhymenium 13–18 μm thick; hymenium ca 94 μm thick; asci clavate with a relative long stalk, 8-spored, pore J+ in Melzer's reagent, 47–55 × 3.5–4 μm; ascospores subfusoid with rounded ends, nonseptate, with several very tiny guttules, irregularly uniseriate to irregularly biseriate, 9–11 × 1.2–1.5 µm; paraphyses lanceolate, 4–6 µm at the widest, exceeding the asci by 25–35 µm.

Holotype: China. Hunan: Yizhang County, Mangshan Nature Reserve, alt. 1200 m, on rotten leaves of dicotyledons, 13-IV-2002, W.Y. Zhuang & Y.H. Zhang 4199, HMAS 82132.

Notes: *Lachnum willisii* (G.W. Beaton) Spooner on the indumentum of living and fading leaves of *Celmisia asteliifolia* from Australia is the most similar species and certainly close-related to the Chinese new species. The former differs from the latter in apothecia smaller, 0.3–0.5 mm in diam and 0.4–0.6 mm high, with a much shorter stipe less than 0.2 mm long, smaller ectal excipular cells 5–8 × 5–6 µm, shorter asci with a short stalk and not markedly narrow at base, 37–43 × 4.5–5 µm, narrower paraphyses exceeding the asci by only 10–15 µm, and thick-walled hairs with a narrow lumen and often shortest at margin (Spooner, 1987).

NAME CHANGES FOR SOME PREVIOUSLY RECORDED SPECIES

Hymenoscyphus phyllophilus (Desm.) Kuntze, Rev. Gen. Plant. iii, 2: 485, 1898. 喜叶膜盘菌

Specimen examined: Jilin Province: Mt. Changbai, on stems of a monocotyledon, 12-IX-1998, S.L. Chen & W.Y. Zhuang 2621, HMAS 78012.

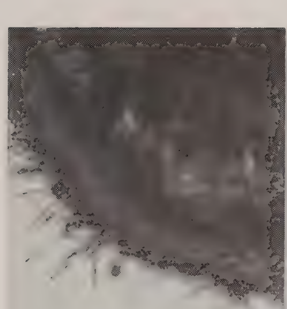
Notes: The fungus was previously recorded as "*Hymenoscyphus* taxonomic sp. #2" with description of the diagnostic features and illustration of the ascospores (Yu et al., 2000). Re-examination of HMAS 78012 indicates that it is very similar to *H. phyllophilus* in the tiny and white apothecia, presence of angular cells in the ectal excipulum, J– asci in Melzer's reagent, and fusoid, 1-septate ascospores. It occurs on a different substrate than reported by Dennis (1956), i.e. stems of a monocotyledon instead of leaves of *Fagus* and *Quercus*.

Lachnum sichuanense (M. Ye & W.Y. Zhuang) W.Y. Zhuang & M. Ye, **comb.** et **stat. nov.**

≡ *Lachnum sclerotii* (A.L. Sm.) J.H. Haines & Dumont var. *sichuanense* M. Ye & W.Y. Zhuang, Nova Hedwigia 76: 448, 2003.

Specimens examined: Sichuan Province: Gonggashan, alt. 2920 m, on twigs of *Rosa* sp., 20-VIII-1997, Z. Wang 2112, HMAS 72055 (holotype); Luding, on rotten twigs of *Rosa* sp., 16-VIII-1997, Z. Wang 2029, HMAS 75904.

Figs. 1–10. Morphology of *Lachnum* spp. Figs. **1–4**. *Lachnum culmicola*: **1**. Longitudinal section of apothecium showing the excipulum, ×245; **2**. Asci and paraphyses, ×245; **3**. Ascospores, ×610; **4**. Hairs with a swollen apex, ×610; all from holotype. Fig. **5**. *Lachnum hyalopus* var. *bambusicola*: **5**. Portion of apothecium in section, ×245; from holotype. Figs. **6–7**. *Lachnum mangshanense*: **6**. Portion of apothecium in section showing excipular structure and hairs, ×245; **7**. Marginal hairs, ×610; all from holotype. Figs. **8–10**. *Lachnum willisiopsis*: **8**. Portion of apothecium in section, ×245; **9**. Asci, ×610; **10**. Portion of hymenium showing paraphysis apices and an ascospore, ×610; all from holotype.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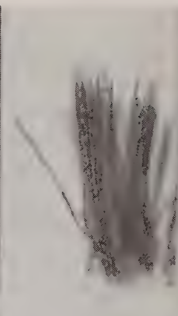
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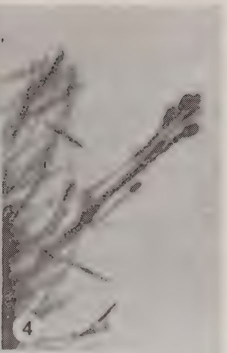
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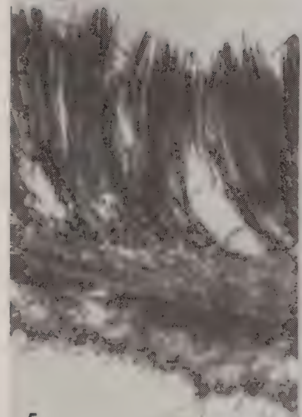
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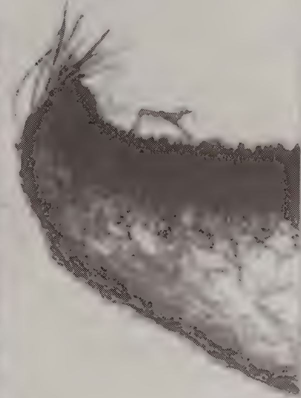
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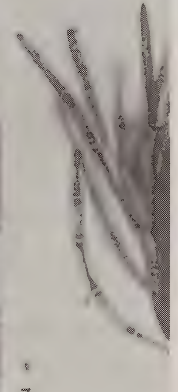
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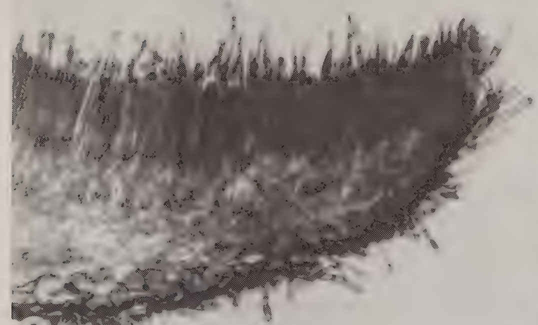
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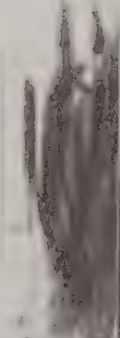
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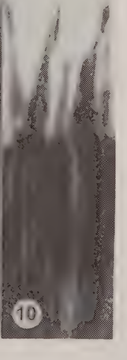
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Notes: When several collections of *Lachnum sclerotii* were examined and compared with the materials of *L. sclerotii* var. *sichuanense* (Ye & Zhuang, 2003), distinctions in the apothecia with pure white receptacle surface and longer stipe, hairs without amber-colored resinous matters, longer asci (93–135 μm vs. 60–92 μm long) with a bifurcate base, wider ascospores (2.6–4 μm vs. 1.8–2.8(–3) μm wide), and presence of angular cells in the ectal excipulum are sufficient to separate the fungus from *L. sclerotii* at species level. A new combination is thus proposed.

Sarcoscypha knixoniana F.A. Harr., Harvard. Pap. Bot. 10: 58, 1997. 尼氏肉杯菌

Apothecia discoid, 6–10 mm in diam when dry, short-stipitate to subsessile; hymenium dull orange to light brownish orange when dry, receptacle surface somewhat lighter than hymenium and wrinkled when dry, appearing glabrous but with short hairs under the microscope; ectal excipulum of textura porrecta, ca 70–75 μm thick; medullary of textura intricata, up to 650 μm thick at flank or even thick at the lower flank, hyphae hyaline, 2.5–8 μm wide; subhymenium well-developed, 50–60 μm thick; hymenium 280–290 μm thick; asci cylindrical, 8-spored, J– in Melzer's reagent, 10–13 μm wide; ascospores ellipsoid with truncate ends, with very shallow depression at ends or without depression, guttules not clearly defined or multi-guttulate, uniseriate, mostly 19–25.5(–28) × 9–12 μm; paraphyses filiform, 1.5–3 μm wide.

Specimens examined: Taiwan Province: Nantou County, on twigs associated with mosses, 29-IV-1993, J.M. Chen, TNM-F 0754; *ibid.*, on twigs, 19-V-1993, J.M. Chen, TNM-F 0993.

Notes: TNM-F 0754 and 0993 were among quite a number of collections previously recorded as *Sarcoscypha humberiana* F.A. Harr. from Taiwan (Wang, 2001). When the holotype of *S. humberiana* (CUP 63489) originally described from Taiwan was compared, differences of these two collections in receptacle surface morphology, anatomic structure, and ascospore width were noticed. They turned out to be *S. knixoniana* which was known only from Japan, the type locality, and is characterized by the small- to medium-sized apothecia, relatively glabrous receptacle surface, well-developed subhymenium, and slightly wider ascospores than that of *S. humberiana* (Harrington, 1997). The spore guttules in the above two collections are not clearly defined or appear multiguttulate.

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The author would like to thank Prof. R. P. Korf, Professor Emeritus of Cornell University, for critical review of the manuscript and valuable suggestions; Dr. Y.-Z. Wang of the National Museum of Natural Science, Taichung for kindly providing facilities and related specimens during the author's visit in 1997 and for sending specimens on loan; Ms. S. C. Gruff of Cornell University for sending specimens on loan; and Ms. X. Song for technical assistance.

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MYCOTAXON

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MELANUSTILOSPORA, A NEW GENUS IN THE UROCYSTALES (SMUT FUNGI)

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ABSTRACT. A new genus, *Melanustilospora,* is proposed for *Melanotaenium ari* and *M. arisari.*

KEYWORDS: taxonomy, *Melanotaenium,* Urocystaceae

According to the classical descriptions (Vánky 1987, 1994; etc.), the species of *Melanotaenium* de Bary possess single, dark-coloured, thick-walled ustilospores, embedded in the host tissue, and spore germination of *Tilletia*-type. For a long time the delimitation between *Melanotaenium* and some dark-spored *Entyloma* species on monocotyledonous host plants was very complicated. On the basis of ultrastructural characters of the septal pore and host-parasite interactions, and a molecular biological investigation, Bauer *et al.* (1997, 2001b) and Begerow *et al.* (1997/1998) demonstrated the heterogeneity of *Melanotaenium*. Recently, that genus was split into several genera: *Melanotaenium* s. str. (in the Melanotaeniaceae – Begerow *et al.* 1997/1998) on dicotyledonous hosts, and *Eballistra* R. Bauer, Begerow, A. Nagler & Oberw. (in the Eballistraceae – Bauer *et al.* 2001a) and *Phragmotaenium* R. Bauer, Begerow, A. Nagler & Oberw. (in the Tilletiariaceae – Bauer *et al. op.c.*) on monocotyledonous hosts. Additionally, some *Melanotaenium*-like species on Poaceae were transferred into *Jamesdicksonia* (in the Georgefischeriaceae – Bauer *et al.* 2001a).

The ultrastructural study of *Melanotaenium* species (Bauer *et al.* 1997) reveals that the members of *Melanotaenium* sensu Bauer *et al.* (*op.c.*) have simple septal pores with membrane caps but without inner non-membranous bands in the pore, whereas "*Melanotaenium*" *ari* has simple septal pores with membrane caps and two non-membranous inner bands closing the pore. Because of that ultrastructural difference, in the recent classificatory system of the smut fungi and allied taxa (Bauer *et al.* 1997, 2001b; Vánky 1999, 2001, 2002) "*Melanotaenium*" *ari* has not been replaced in the Melanotaeniaceae but in the Urocystaceae, together with *Mundkurella*, *Urocystis*, *Ustacystis*, and *Vankya*.

Based on the diagnostic complex of classical morphological characters (Vánky 1990, 1994), the members of these four genera are well distinguished from "*Melanotaenium*" *ari*. The sori of "*Melanotaenium*" *ari* are not powdery at maturity. It produces one kind of single ustilospores, embedded in the host tissue. The species of *Urocystis* and *Ustacystis* are spore-ball and/or spore-pair forming taxa. The species of *Mundkurella* possess two kinds of ustilospores. At maturity, the ustilospores of *Mundkurella* and *Vankya* are not embedded in the host tissue.

For accommodation of *Melanotaenium ari* in the Urocystaceae, as well as for the second member of *Melanotaenium* on Araceae, *M. arisari*, a new genus is proposed:

Melanustilospora Denchev, ***gen. nov.***
Fungi Urocystacearum sensu Begerow, Bauer et Oberwinkler (1997/1998, Canad. J. Bot., 75: 2052). Septae hypharum simpliciter perforatae, pori galeis membranaceis induti et fasciculis nonmembranaceis clausi. Sori epidermide tecti, nonpulveracei. Ustilosporae singulae, fuscae; paries crassus.

Typus: *Melanustilospora ari* (Cooke) Denchev

Etymology: *melan-* (in Gk.), very dark; *ustilospora* (in L.), ustilospore.

Members of the Urocystaceae *sensu* Begerow *et al.* (1997/1998) having simple septal pores with membrane caps and non-membranous bands closing the pores. Sori embedded in the host tissue, not powdery. Ustilospores single, dark-coloured, thick-walled.

Melanustilospora ari (Cooke) Denchev, ***comb. nov.***
Basionym: *Protomyces ari* Cooke, Grevillea **1:** 7, 1872. — *Melanotaenium ari* (Cooke) Lagerh., Bull. Soc. Mycol. France **15:** 98, 1899. — Type on *Arum maculatum* L., England, Chichester, V.1872, F.V. Paxton.

For its description, synonyms, and illustrations see Vánky (1994).

On Araceae: *Arum*, *Biarum* spp., and probably other members of this family, Europe.

Melanustilospora arisari (Peglion) Denchev, ***comb. nov.***
Basionym: *Melanotaenium plumbeum* (Rostr.) Pirotta f. *arisari* Peglion, Malpighia **8:** 425, 1894. — *Melanotaenium arisari* (Peglion) Cif., Bull. Soc. Bot. Ital. **1924:** 57, 1924. — Type on *Arisarum proboscideum* (L.) Savi, Italy, Avellino, «torrente di Capriglia», V.1894.

For its description see Ciferri (1924, 1938).

On Araceae: *Arisarum proboscideum* (L.) Savi, Europe. Known hitherto only from the type locality.

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TAXONOMIC NOTES ON SOME CETRARIOID LICHENS

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ABSTRACT: Three rare Asiatic cetrarioid lichen species (fam. Parmeliaceae, lichenized Ascomycota) are characterized in detail; new combinations are proposed for two of them (*Tuckermannopsis weii* and *Cetreliopsis hypotrachyna*) and the generic position of the third ("*Nephromopsis*" *hengduanensis*) is discussed. Four chemotypes are distinguished in the genus *Cetreliopsis* according to the medullary β-orcinol depsidones present.

KEYWORDS: *Cetreliopsis hypotrachyna*, "*Nephromopsis*" *hengduanensis*, *Tuckermannopsis weii*, chemotypes

Tuckermannopsis weii (X. Q. Gao & L. H. Chen) Randlane & Saag comb. nov.
Basionym: *Nephromopsis weii* X. Q. Gao & L. H. Chen, Mycotaxon 77: 492, 2001. – Type: China, Prov. Fujian, Wuyi Mt., alt. 1800 m, 26°54'N 116°42'E, 24.04.1988, *X. Q. Gao* (HMAS-L – holotype, isotype!, UPS – isotype).

The taxon was recently described from China; its generic position was the subject of a short discussion with the conclusion to include it in the genus *Nephromopsis* (Chen & Gao 2001). However, several characters contradict the placement of this taxon in *Nephromopsis*: the brown colour of the upper surface, caused by the absence of usnic acid in the cortex; the presence of pseudocyphellae on both upper and lower surfaces and the clearly globose shape of ascospores. Phylogenetic analysis of cetrarioid lichens with globose ascospores has been carried out on two different data sets – on morphological (including anatomical and chemical) and on molecular characters (Saag *et al.* 2002). "*Nephromopsis*" *weii* was the only representative of *Nephromopsis* which was included in the ingroup – due to the presence of globose ascospores; all the other taxa of the genus are characterized by ellipsoid ascospores (6–12 x 3–6 µm) (Randlane *et al.* 1995). Analysis of the morphological data matrix showed clearly that "*Nephromopsis*" *weii* had close affinities with the species of *Tuckermannopsis*, especially *T. subalpina* and *T. inermis* (Fig. 1). Unfortunately, the genus *Tuckermannopsis* has been a kind of a "warehouse" where several cetrarioid species, the generic position of which was not obvious, were transferred since the 1980-s (Table 1). More recently there has been an attempt to delimit this genus based on morphology and DNA sequences (Kärnefelt

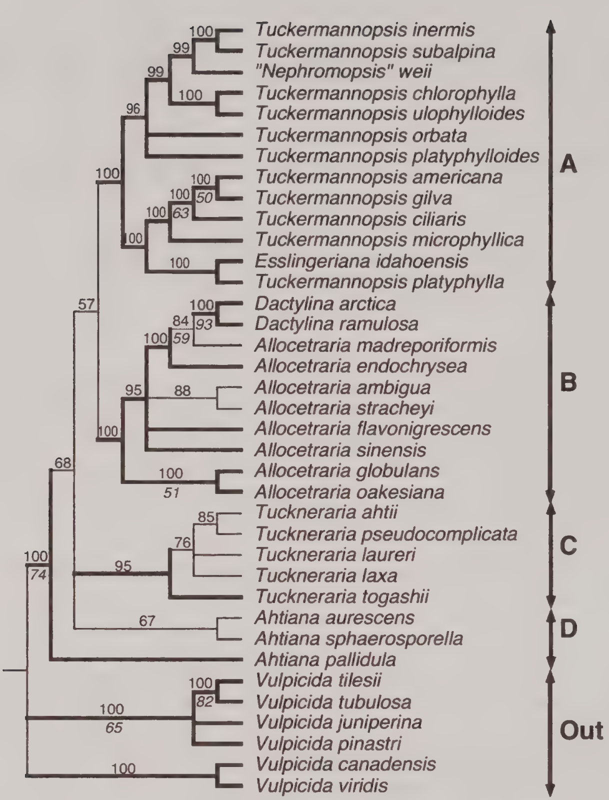
Tuckermannopsis inermis
Tuckermannopsis subalpina
"Nephromopsis" weii
Tuckermannopsis chlorophylla
Tuckermannopsis ulophylloides
Tuckermannopsis orbata
Tuckermannopsis platyphylloides
Tuckermannopsis americana
Tuckermannopsis gilva
Tuckermannopsis ciliaris
Tuckermannopsis microphyllica
Esslingeriana idahoensis
Tuckermannopsis platyphylla
Dactylina arctica
Dactylina ramulosa
Allocetraria madreporiformis
Allocetraria endochrysea
Allocetraria ambigua
Allocetraria stracheyi
Allocetraria flavonigrescens
Allocetraria sinensis
Allocetraria globulans
Allocetraria oakesiana
Tuckneraria ahtii
Tuckneraria pseudocomplicata
Tuckneraria laureri
Tuckneraria laxa
Tuckneraria togashii
Ahtiana aurescens
Ahtiana sphaerosporella
Ahtiana pallidula
Vulpicida tilesii
Vulpicida tubulosa
Vulpicida juniperina
Vulpicida pinastri
Vulpicida canadensis
Vulpicida viridis
A
B
C
D
Out
100
99
99
100
96
100
100
100
50
100
63
100
100
57
100
84
93
100
59
95
88
100
68
100
51
85
76
100
74
95
67
100
82
100
65
100

Fig. 1. Majority rule consensus tree of 7436 equally parsimonous cladograms (based on characters with equal weights), obtained as a result of the maximum parsimony analysis of the morphological data set. The length of shortest trees 136, consistency index 0.382, retention index 0.684. The values above branches correspond to the percentages of equally most parsimonous trees with that specific bipartition; consensus 95% and more is shown with thicker branches. Bootstrap values greater than 50% are indicated below branches. Letters 'A-D' indicate informal entities of the ingroup, letters 'Out' indicate outgroup taxa.

& Thell 2001). Still, molecular data were only available for four *Tuckermannopsis* species (Kärnefelt & Thell 2001; Saag *et al.* 2002; Thell *et al.* 2002) and did not permit serious phylogenetic analysis based on DNA sequences. The diagnostic characters for *Tuckermannopsis sens. str.* include a brown or greenish upper surface of the foliose or subfruticose thallus, with or without pseudocyphellae; cylindrical asci with small tholus and broad axial body; subglobose to globose ascospores (4–8 x 4–8 µm); absence of usnic acid in the cortex and presence of various aliphatic and aromatic compounds in the medulla. "*Nephromopsis*" *weii* corresponds to all these characters, the only exception being that pseudocyphellae are present both on its upper and lower surfaces.

Our studies of the isotype material of "*Nephromopsis*" *weii* indicate that this taxon is certainly not a member of the genus *Nephromopsis* and, therefore, the new combination *Tuckermannopsis weii* is proposed here.

Additional anatomical data: ascospores globose, Ø 4.8–5.4 µm; asci small, clavate to cylindrical, 24–32 x 8–10 µm; axial body rather broad, 2–3 µm.

Table 1. Species which have been combined in the genus *Tuckermannopsis*; generic name in quotation marks (under Current position) indicates that the generic position of the species is still doubtful; "true" *Tuckermannopsis* species are in bold.

Taxon	Author of combination in *Tuckermannopsis*	Current generic position	Author of current generic position
T. aurescens	Hale in Egan 1987	*Ahtiana*	Thell et al. 1995a
T. canadensis	Hale in Egan 1987	*Vulpicida*	Mattsson & Lai 1993
T. chlorophylla	Hale in Egan 1987	***Tuckermannopsis***	
T. ciliaris	Gyelnik 1933	***Tuckermannopsis***	
T. coralligera	Weber in Egan 1991	*Tuckermanella*	Esslinger 2003
T. endoxantha	Gyelnik 1933	*p.p. Nephromopsis endocrocea*	Asahina 1935
T. fendleri	Hale in Egan 1987	*Tuckermanella*	Esslinger 2003
T. gilva	Lai 1981	***Tuckermannopsis***	
T. halei	Lai 1981	***Tuckermannopsis americana***	Hale in Egan 1987
T. hepatizon	Kurokawa 1991	*Melanelia*	Thell 1995
T. inermis	Kärnefelt et al. 1993	*"Tuckermannopsis"*	Kärnefelt & Thell 2001
T. juniperina	Hale in Egan 1987	*Vulpicida*	Mattsson & Lai 1993
T. merrillii	Hale in Egan 1987	*Kaernefeltia*	Thell & Goward 1996
T. microphyllica	Lai 1981	***Tuckermannopsis***	
T. oakesiana	Hale in Egan 1987	*Allocetraria*	Thell et al. 1995b
T. orbata	Lai 1981	***Tuckermannopsis***	
T. pallidula	Hale in Egan 1987	*Ahtiana*	Thell et al. 1995a
T. pinastri	Hale in Egan 1987	*Vulpicida*	Mattsson & Lai 1993
T. platyphylla	Hale in Egan 1987	*"Tuckermannopsis"*	Kärnefelt & Thell 2001
T. platyphylloides	Lai 1981	*"Tuckermannopsis"*	Kärnefelt & Thell 2001
T. sepincola	Hale in Egan 1987	*"Cetraria"*	Thell 1996
T. subalpina	Kärnefelt et al. 1993	*"Tuckermannopsis"*	Kärnefelt & Thell 2001
T. ulophylloides	Lai 1981	***Tuckermannopsis***	
T. viridis	Hale in Egan 1987	*Vulpicida*	Mattsson & Lai 1993
T. weii	Randlane & Saag 2003	***Tuckermannopsis***	

Nephromopsis hengduanensis L. H. Chen, Mycotaxon 77: 493, 2001. – Type: China, Prov. Yunnan, Weixi County, alt. 3350 m, 27°09'N 99°17'E, 13.07.1981, *X. Wang et al. 4507* (HMAS-L – holotype!).

This is another cetrarioid lichen recently described from China (Chen & Gao 2001). It is characterized by a yellowish foliose thallus; numerous small orbicular pseudocyphellae on the lower surface and sparse pseudocyphellae on the upper surface, situated mainly on plug-like outgrowths; nephromoid apothecia with broadly clavate asci and extremely large ellipsoid ascospores, the presence of usnic, lichesterinic, protolichesterinic, caperatic and olivetoric acids. The large ascospores (27–30 x 16–18 μm) with a thick epispore (2–3 μm) (Fig. 2) are unusual in the group of cetrarioid lichens: rather analogous spores are only known in the genus *Parmelaria* and similar but still smaller spores – in *Cetrelia* (Elix 1993). The haematecium is composed of branched (anastomosing) paraphyses and large, broadly clavate asci (80–88 x 32–37 μm) (Fig. 3). According to the classification of ascus forms in the fam. *Parmeliaceae* (Thell *et al.* 1995), this corresponds to the *Parmelia*-form which is characteristic of *Parmelia* s. str., *Cetrelia*, *Parmelaria*, *Parmotrema* etc. Species belonging to *Nephromopsis* have much smaller ellipsoid spores (6–12 x 3–6 μm) borne in narrowly clavate and small asci (30–45 x 9–12 μm) (Randlane & Saag 1998). This provides compelling evidence for placing this species in a genus other than *Nephromopsis*.

The possibility of transferring the species to the genus *Cetreliopsis* was discussed briefly by the authors of "*N.*" *hengduanensis* (Chen & Gao 2001) and then discarded due to the lack of fumarprotocetraric acid in the medulla of "*N.*" *hengduanensis*. We share this opinion as the genus *Cetreliopsis* is characterized by a well-defined cohort of characters including the presence of pseudocyphellae on both surfaces, ellipsoid ascospores of c. 6–12 x 4–7 μm and occurence of fumarprotocetraric acid together with other closely related β-orcinol depsidones in the medulla (Randlane *et al.* 1995). "*N.*" *hengduanensis* corresponds to this description by having pseudocyphellae both on upper and lower surfaces but differs essentially in its ascospore characters and medullary chemistry.

Some morphological characters (e.g. presence of pseudocyphellae on both surfaces, emergent marginal pycnidia) of "*N.*" *hengduanensis* are similar to those of two other cetrarioid lichens known from high altitudes of southern Asia – "*Cetraria*" *leucostigma* and "*Cetraria*" *melaloma*. Unfortunately, the generic location of these taxa is also undetermined as neither their ascospores nor pycnidiospores have been seen or studied (Randlane *et al.* 1997; 2001). The systematic position of all three species ("*Cetraria*" *leucostigma*, "*Cetraria*" *melaloma* and "*Nephromopsis*" *hengduanensis*) has yet to be determined, and will most probably be dependent upon the phylogenetic analysis of molecular characters.

Cetreliopsis hypotrachyna (Müll. Arg.) Randlane & Saag comb. nov.
Basionym: *Cetraria hypotrachyna* Müll. Arg., Flora 74: 373. 1891. – Type: India, Manipur, on twigs, *G. Watt, 6949* (BM - holotype!).

This is a folious nephromoid lichen of yellowish colour (containing usnic acid). It was described at the end of the 19th century based upon one specimen, and is still known only from the type locality (Manipur in north-eastern India). This is probably the reason why the species is still included in the genus *Cetraria*, although, according to the revised definition of the genus, *Cetraria* s. str. is characterized by brown fruticose thallus, a two-layered cortex, clavate to cylindrical asci with an apical ring structure and small axial body (Kärnefelt *et al*. 1993).

Cetreliopsis hypotrachyna is a poorly known taxon due to its extreme rarity. Its description has been published in a few papers dealing with Indian lichen flora (Awasthi 1983; 1988). The following, revised description (composed after study of the holotype) presents additional morphological, anatomical and chemical data.

Thallus foliose, dorsiventral, adnate, coriaceous; upper surface greenish yellow, lower surface dark brown to almost black. Lobes rounded, rather wide (to 10 mm). Upper side ± smooth in the younger parts and moderately reticulated in older parts of the thallus, lower surface strongly reticulately rugose, with black simple or irregularly branched rhizines. *Medulla* white to very pale orange. *Pseudocyphellae* present on both surfaces: on the upper side mainly in the submarginal zone in the form of small whitish patches and often with black emergent pycnidial projections; on the lower side rather sparse, in the form of tiny greyish dots located on the thallus ridges. Soredia, isidia and cilia absent. Pycnidia marginal and laminal on both surfaces (occasionally also on the lower side!), on black emergent projections. *Apothecia* marginal, up to 6 mm in diameter, with dark brown disk; epithecium yellowish brown, hymenium c. 35–40 µm, asci clavate, c. 30–33 x 11–13 µm, ascospores broadly ellipsoid, 7–8 x 4–5 µm. *Pycnoconidia* bifusiform, 4 x 1 µm. *Secondary compounds*: usnic acid in the cortex, salazinic acid as the major and norstictic acid as a minor compound in the medulla. *Distribution and habitat*: India; corticolous.

As mentioned above, the generic position of this species had remained unclear for many years. The morphological and anatomical characters, particularly the presence of pseudocyphellae on both surfaces and the occurrence of emergent, laminal pycnidial projections coincide with the diagnostical characteristics of the genus *Cetreliopsis*. *Cetreliopsis* is also clearly distinguished chemically by containing a complex of β-orcinol depsidones – protocetraric, fumarprotocetraric, salazinic, quaesitic acids and other closely related compounds – in the medulla, together with some fatty acids (Randlane *et al*. 1995, Lai & Elix 2002). Furthermore, chemosyndromic variation can be recognized in *Cetreliopsis* species, analogous to that which was identified, for example, in the genus *Cetrelia* (Culberson & Culberson 1976, Randlane & Saag 1991). Different chemotypes are distinguished by the major medullary constituents (one or two) which are constant in one chemotype, while the minor substances may vary somewhat. Major compounds of one chemotype often appear as minor in another, and most of those medullary compounds are biogenetically closely related. In the genus *Cetreliopsis* four different chemotypes can be identified (Tabel 2; Fig 4).

Cetreliopsis hypotrachyna is the only representative of the chemotype IV, with salazinic acid as the major and norstictic acid as a minor component. Salazinic acid, the natural precursor of recently identified quaesitic acid (earlier reported as unknown Cph-1) (Lai & Elix 2002), is present in chemotypes II and III as a minor substance. Norstictic acid has not been identified in the other chemotypes of *Cetreliopsis*. Even so, it is chemically and biogenetically close to salazinic acid and has been interpreted as a precursor of the latter (Huovinen & Ahti 1982). Both these substances (as well as quaesitic acid) belong

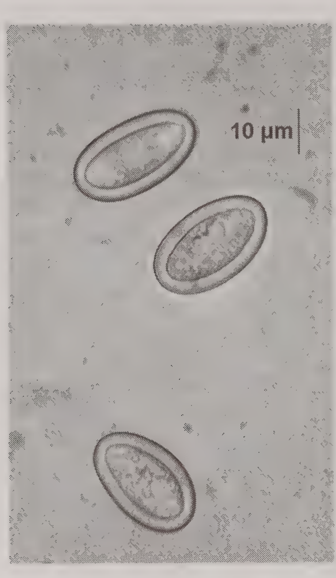

Fig. 2. Large ascospores with thick epispore of *Nephromopsis hengduanensis.*

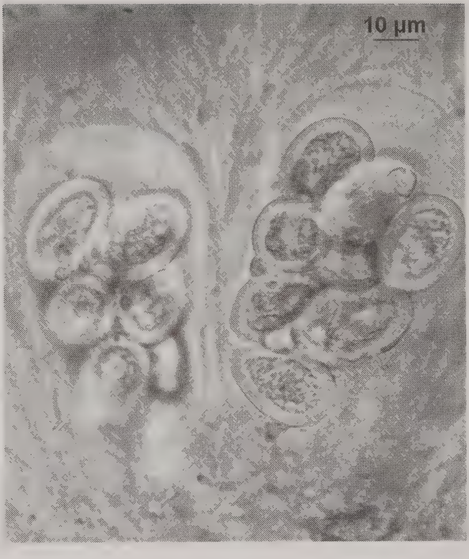

Fig. 3. Branched (anastomosing) paraphyses and large, broadly clavate asci of *Nephromopsis hengduanensis.*

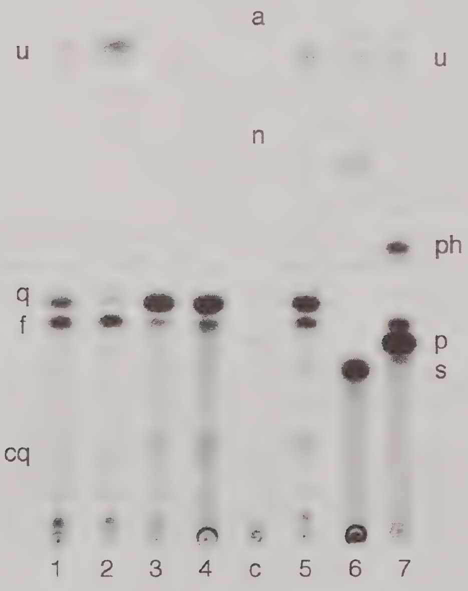

Fig. 4. Secondary compounds of *Cetreliopsis* species on TLC plate (run in solvent G, in UV 254 nm): 1 – *C. rhytidocarpa* ssp. *langtangi* Randlane & A. Thell, 2– *C. papuae* Randlane & Saag, 3 – *C. laeteflava* (Zahlbr.) Randlane & Saag, 4 – *C. thailandica* Elix & M. J. Lai, 5 – *C. endoxanthoides* (D. D. Awasthi) Randlane & Saag, 6 – *C. hypotrachyna* (Müll. Arg.) Randlane & Saag, 7 – *C. asahinae* (M. Satô) Randlane & A. Thell. Abbreviations of substances: a – atranorin, cq – conquaesitic acid, f – fumarprotocetraric acid, n – norstictic acid, p – protocetraric acid, ph – physodalic acid, q – quaesitic acid, s – salazinic acid, u – usnic acid.

to the group of depsidones with lactone ring; they only differ from each other by the substituent at position 5 (CH_3 in norstictic acid and CH_2OH in salazinic acid).

Thus, the transfer of this species from *Cetraria* into *Cetreliopsis* is supported by morphological-anatomical as well as chemical characters.

Tabel 2. Chemotypes in the genus *Cetreliopsis*. Presence of medullary compounds: M – major substance, m – minor substance, + – traces.

Chemotype	Species	Medullary compounds								
		β-orcinol depsidones without lactone ring				β-orcinol depsidones with lactone ring				
		Protocetraric acid	Fumarprotocetraric acid	Succinprotocetraric acid	Physodalic acid	Salazinic acid	9α-O-methylsalazinic acid	Quaesitic acid	Conquaesitic acid	Norstictic acid
I	*C. asahinae*	M	m		m					
II	*C. papuae*	+	M	+		+	+	m	+	
	C. rhytidocarpa	+	M	+		+	+	m	+	
III	*C. endoxanthoides*	+	m			+		M	m	
	C. laeteflava	+	m			+		M	m	
	C. thailandica	+	m			+	+	M	m	
IV	*C. hypotrachyna*					M				M

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The authors are grateful to the keepers of HMAS, BM and UPS for kindly sending the type materials. This study was financially supported by the Estonian Science Foundation, grant no. 5505. Triin Randlane is acknowledged for revising the English. Special thanks are due to Jack Elix for the comments on the manuscript.

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LOPHODERMIUM ERIOPHORI COMB. NOV.

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Abstract: *Lophodermium eriophori* is proposed as a new combination for *Lophium eriophori*. A description of the fungus is provided from the type specimen, and its relationship with *Lophodermium tumidulum* and *Coccomyces tumidus* is discussed.

Keywords: *Lophium eriophori*, *Lophodermium tumidulum*, *Coccomyces tumidus*, *Eriophorum vaginatum*, *Lophodermium juncinum*

Introduction

Lophium eriophori was described by Hennings (1895) for a fungus with macroscopically distinctive, conchiform ascomata on the dead leaves of *Eriophorum vaginatum* (Cyperaceae). The hysteriaceous appearance of the ascomata no doubt influenced the choice of genus for this species. However, Zogg (1962), in his monograph of the Hysteriaceae and Lophiaceae, excluded this fungus from the Lophiaceae, noting that he considered it a discomycete with an excipulum.

Scheuer (1988) considered *L. eriophori* to belong to the Rhytismataceae. He listed it amongst the *Lophodermium* species he discussed (as "*Lophium*" *eriophori* P. Henn.), but did not propose a recombination. Based on published descriptions, he noted similarities with two other Cyperaceae-inhabiting Rhytismataceae, *Coccomyces insignis* P. Karst. and *Lophodermium tumidulum* Sacc., E. Bommer & M. Rousseau.

Johnston (2001) noted macroscopic and anatomical similarities between recent collections identified as *Lophium eriophori*, *Lophodermium tumidulum*, *L.* cf. *juncinum* (Jaap) Terrier, *Coccomyces insignis*, and *C. tumidus* (Fr.) De Not. He grouped these species informally as *Lophodermium* Group C.

A modern description of *Lophium eriophori* is provided, and a new combination into *Lophodermium* proposed. All macroscopic and microscopic features are described from herbarium material, rehydrated in 3% KOH where appropriate. Hymenial elements were mounted in 3% KOH. Ascomata were sectioned at about 10 _m using a freezing microtome, following rehydration in 3% KOH. Sections were mounted in lactic acid.

Taxonomic part

Lophodermium eriophori (Henn.) P.R. Johnst. & Scheuer, comb. nov. (Figs 1–6)
Lophium eriophori Henn., *Verhandlungen des Botanischen Vereins der Provinz Brandenberg 37*: 2, 1895.

Ascomata developing on dead leaves, not associated with bleaching of host tissue, or with zone lines; conidiomata not seen. Ascomata 0.5–0.8 x 0.4–0.6 mm, ovate to broad-elliptic in outline, prominent above the leaf surface, appearing more or less superficial, opening by a single longitudinal slit, distinctly sunken along the opening slit; wall dull-black, no lip cells along opening slit; hymenium appears yellowish when fresh, black when dry, orange-brown following rehydration. Ascomatal insertion subcuticular. In vertical section upper wall of ascoma up to 45 µm thick near edge of the opening, comprising a loose tissue of globose cells 5–7 µm diam. with walls hyaline, outer 2–3 layers of cells with walls encrusted with dark brown material, this more thickly deposited on the outermost cells. Upper wall about 30 µm wide near the base, comprising angular to short-cylindric cells, walls encrusted with dark brown material. Lower wall up to 20 µm thick, comprising tangled hyphae 2.5–3 µm diam. with walls slightly thickened, brown. Subhymenium 45–55 µm thick, comprising loose, tangled 2.5–5 µm diam. hyphae with thin, hyaline walls. Paraphyses 1.5–2 µm diam., anastomosing near base, sparingly branched near apex, gently circinate. Asci 235–270 × 15–20 µm, subclavate to subfusoid, tapering to small subtruncate apex, wall undifferentiated at apex, 8-spored, well-developed basal stalk at maturity with spores confined to upper 165–200 µm of ascus. Ascospores 110–160(–175) × 2–3 µm, tapering slightly and gradually to both ends, ends rounded, spores broadly spaced within ascus, surrounded by a well-developed gelatinous sheath, sheath mostly lost following spore release, with apical and basal cylindric, 8–10 × 4–6 µm gelatinous caps, the basal cap curved, spores typically 1–septate at maturity, hyaline.

NOTES: *Lophodermium eriophori* is known only from *Eriophorum vaginatum*, from two sites in Germany. The broad north-temperate distribution of its host suggests, however, that with further collecting this fungus will be found to have a wide geographic distribution across the Northern Hemisphere.

The thin-walled asci, anastomosing paraphyses, and ascospores surrounded by a gelatinous sheath, as found in *L. eriophori*, are all features characteristic of the Rhytismataceae (Johnston 2001). Within this family, *L. eriophori* is macroscopically and anatomically close to *Lophodermium tumidulum* and *Coccomyces tumidus*. The three species can be distinguished on the basis of ascospore size: 60–90 × 2–3 µm in *L. tumidulum*, 35–45 × 3.5–4 µm in *C. tumidus* (Johnston 2001), and 110–160(–175) × 2–3 µm in *L. eriophori*. *Lophodermium juncinum* may be also closely related. Specimens on *Juncus* tentatively referred to this species by Johnston (2001) are certainly similar to the three species discussed above, but the type specimen of *L. juncinum* has not been examined. These *Juncus*-inhabiting specimens have ascospores 95–120 × 1.5–2.5 µm (Johnston 2001). The description of the *Carex*-inhabiting *Coccomyces insignis* also appears to match this group of Cyperaceae-inhabiting species of Rhytismataceae; however, the fragmentary nature of the type

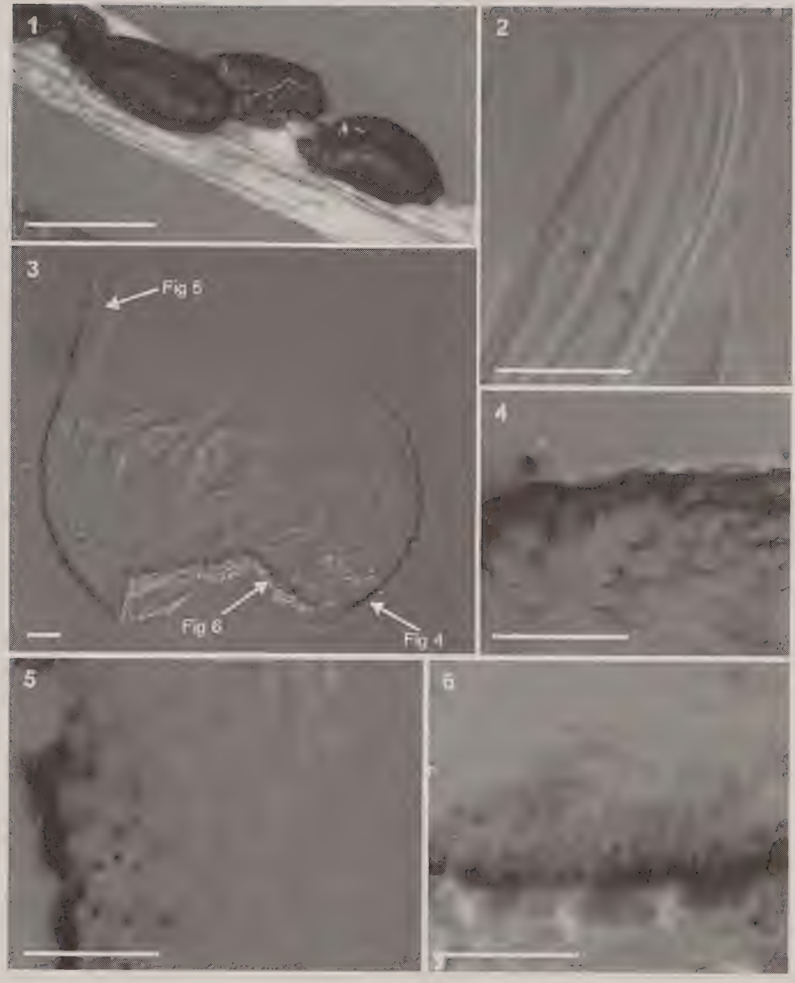

Fig 1–6 *Lophodermium eriophori* (holotype, S). **Fig. 1** Ascomata. **Fig. 2** Ascus apex, ascospores surrounded by well-developed gelatinous sheath. **Fig. 3** Ascoma in vertical section. **Fig. 4** Detail from Fig. 3, showing host cuticle partially covering upper wall of ascoma. **Fig. 5** Detail from Fig. 3, showing structure of upper wall of ascoma, near ascomatal opening. **Fig. 6** Detail from Fig. 3, showing lower wall of ascoma. Scale bars: Fig. 1 = 1 mm; Fig. 2 = 50 µm; Fig. 3–6 = 20 µm.

specimen of *C. insignis* precludes a more precise conclusion (Sherwood 1980, Johnston 2001).

SPECIMENS EXAMINED: GERMANY: Hundekehle, Berlin, on *Eriophorum vaginatum*, coll. P. Hennings, Oct. 1894 (S - holotype). — Bayern, Wildseefilz near Peustelsau, W of Bad Kohlgrub, 47°40'N/10°57'E, ca. 900 m alt., on *Eriophorum vaginatum* (possibly also on very few admixed leaf fragments of other grass-like monocots), mainly on leaves and stems buried in soft *Sphagnum* cushions, 3–15 cm under the surface, coll. C. Scheuer (1155), 29 Aug. 1987 (GZU).

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MYCOTAXON

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BOOK REVIEWS AND NOTICES

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GENERAL

Higher Fungi of Tropical China. Edited by Wen-Ying Zhuang. 2001. Mycotaxon, 316 Richard Place, Ithaca, NY 14850-0264, USA. [available from the Editor, P.O. Box 2714, Beijing 100080, People's Republic of China.] Pp. v + 485. ISBN 0 930845 3 7. Price: US $ 50.

This multi-authored work examines the fungi recorded from tropical China (including Hong Kong and Taiwan), defined as occurring south of the Tropic of Cancer. It is mainly based on material in HMAS (Systematic Mycology and Lichenology Laboratory, Institute of Microbiology, Chinese Academy of Sciences, Beijing), and details of localities from which there is material in the collections are mapped and listed, these are dispersed through 88 counties. Many new collections were made for the study, which was supported by the National Natural Science Foundation of China. All ten contributors are from the HMAS staff. There are separate chapters on: lichenized fungi, non-lichenized discomycetes, ascomycetes excluding discomycetes and lichens, imperfect fungi, aphyllophorales in a broad sense, agarics and other macromycetes, *Uredinales,* and *Ustilaginales.* Slime moulds and straminipilous fungi are not treated. The editor has ensured that the presentations are largely comparable, with information on the host or substrate and localities, with references to all the sources of the records: herbarium material or literature records. Professor R. P. Korf was a source of 'continuous inspiration' in this venture. and some other American mycologists also helped, notably Drs J. H. Haines, A. Y. Rossman, and G. J. Samuels.

There is also a valuable list of other major publications on syntheses of Chinese fungi, and records from books and papers issued in 2000 have been captured (e.g. Lu *et al.* 2000). I was pleased to see the lichenized fungi included, a necessity better understood in China than many countries, but it would have been helpful to provide a synoptic classification integrating these into families and higher taxa along with other fungi. In addition, I would also have welcomed coverage of the 'lower' fungi as these are generally also studied by mycologists and include in fungal inventories. If these groups are no longer to be studied by mycologists, what other discipline will take them on?

Although only a relatively small part of China is covered, records of a most commendable 5056 species belonging to 1192 genera are presented. This compares with the 2400 species in 601 genera for all China in Teng (1996), which did include slime moulds and straminipiles, but not lichenized fungi. This represents an enormous achievement, making much information available that has previously been dispersed in the major Chinese fungal herbarium and Chinese literature accessible internationally for the first time. All involved are to be congratulated on a remarkable synthesis which will be a major spur to tropical mycology in China, and also demonstrates what can be achieved when funding is available.

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[1] Books for consideration for coverage in this column should be mailed to the Book Review Editor (address above) in the first instance. Fax (+34) 91 857 3640; e-mail: myconova@terra.es.

Lu, B. S., Hyde, K. D., Ho, W. H., Tsui, K.M., Taylor, J. E., Wong, K. M., Yanna & Zhou, D. Q. (2000) *Checklist of Hong Kong Fungi.* Hong Kong: Fungal Diversity Press.
Teng, S. C. (1996) *Fungi of China.* Ithaca: Mycotaxon.

Estado Actual del Conocimiento de la Micobiota en Venezuela. By Teresa Iturriaga, Iris Páez, Nelly Sanabria, Otón Holmquist, Lilian Bracamonte & Héctor Urbina. 2000. Ministerio del Ambiente y de los Recursos Naturales Renovables, Caracas, Venezuela. [Documentos Técnicos de la Estrategia Nacional de Diversidad Biológica No. 2.] Pp. 147. ISBN 980 04 1215 8. Price: Available on request from the first author while stocks last.

This is a remarkable compilation of the mycological exploration and resources of Venezuela, the equivalent of which does not exist for any other country to my knowledge. It provides surveys of the history of exploration in different regions, gives an overview of the main features of the mycobiota in the various regions and at different altitudes, lists the principle publications on different groups of fungi, details herbaria and other institutions and their mycological holdings, culture collections, mycological training courses, etc. Around 40 000 collections of fungi have been made in the country but only 50 % have been properly identified; these represent about 6500 species, considered a small number for one of the world's most biodiverse countries. Appendices compile information on papers presented at national congresses in the last ten years, genera, those who have worked on fungi, the genera represented in the major collections, details of the different herbaria and their mycological holdings, and an overview of the state of mycology in Latin America. The latter survey was arranged through the Latin American Mycological Association and considers not only the problems facing mycology in the region, but also potential solutions. As to be expected the text is in Spanish, but the last appendix and abstract are also presented in English. This is major source book for all concerned with mycology in Venezuela, and to some extent other parts of Latin America, and takes a holistic view of the subject – embracing lichens and all applied aspects of the subject. While the problems facing such countries are certainly daunting, that mycologists living there are recognizing the situation and endeavouring to stimulate action is gratifying and augers well for the future of mycology in the region.

BASIDIOMYCETES

Mushrooms of Nepal. By Mahesh Kumar Adhikari. May 2000. G. Adhikari, 21/835 Adhikari Niwas, Alka Basti, Katmandu, Nepal. [Distributed by E. Sano, Nakashizu 4-16-19, Sakura-City 285-0843, Japan.] Pp. 236. ISBN 99933 545 0 3. Price US $ 35 (or US $ 43 including postage).

It is a pleasure to introduce this synthesis of knowledge of the mushrooms of Nepal by the leading Nepalese specialist of these fungi, which only recently came to my attention. It starts with an geographic profile, the history of exploration from Berkeley's studies based on J. D. Hooker's visit in 1854 through to recent expeditions and additions by the author. There were 606 species recorded up to the author's studies, and he added at least a further 170 species (however, '210 spp.' are mentioned as his new finds for Nepal on the back cover). A very broad view of 'mushrooms' is taken, many smaller ascomycetes being covered (e.g. *Cheilymenia coprinaria*). For each species, information is given as to habitat, localities, published reports, and world distribution. The genera *Amanita, Lactarius,* and *Russula*, and also 'gasteromycetes', are singled out for special attention, with keys – and in the case of *Russula* also information on spore ornamentation, cystidia, etc (with tables and line drawings).

Ethnomycology features strongly, with discussions on their place in Hindu mythology and the Ayureveda, Sanskrit names, lists of edible (110 spp.), toxic and medicinally important species, information on species sold in local markets (with prices per 'perungo' – woven baskets they are sold in). A biogeographic analysis follows, with a plea for conservation and sustainable use. An extensive reference list is included, and an index provided. Eight pages of colour photographs illustrate not only examplar species, but also mushroom stamps and market-stall scenes.

This is certainly a book that will be valued both by visitors to the country with mycological leanings, and to mycologists elsewhere interested in knowing what species have been found in such a fascinating environment.

Mushrooms of West Virginia and the Central Appalachians. By William C. Roody. 2003. The University Press of Kentucky, 663 South Limestone Street, Lexington, KY 40508-4008, USA. Pp. xii + 520, col. plates 400. ISBN 0 81312262 7 (hardback), 0 8131 9039 8 (paperback). Price US $ 60 (hardback), US $ 35 (paperback).

A first-rate field-guide I would have liked to have had in my pack when out lichening in the Appalachians a few years ago where the mushrooms were often so spectacular. The author is one of the most experienced field mycologists in North America, a particular authority on boletes (*cfr North American Boletes,* reviewed in *Mycotaxon* **78**: 511, April-June 2001), and one of the mainstays of the North American Mycological Association. He lives and works in West Virginia, and the guide is full of his enthusiasm for the mushrooms of his own 'patch'. 'Every outdoor excursion offers the chance of finding a previously unencountered mushroom.' 'The real possibility exists of discovering a species that is completely new to science'. It is with the help of such guides that the next generation of field mycologists will be formed and fired.

The guide starts with general information on collecting and examination, all pertinent and pragmatic (including how to make spore prints without removing the stipe using a wine glass and perforated stiff white paper), but in ten pages one is into the meat. The *ca* 400 species treated are grouped into 11 sections based on features such as 'gilled mushrooms', 'coral mushrooms & look-alikes', 'cup fungi'. And even 'mycoparasites'. For each species there is a first-rate colour photograph, information on scientific and common names, frequently used synonyms, systematic placement (order and family), a description including microscopic features, and notes on occurrence, edibility, and diagnostic features. There is also a glossary, list of sources and recommended reading (mainly books rather than primary scientific papers) and resources, and an index including common names.

My one small regret is a lack of an overall synthesis of the macromycobiota of the region the author knows so intimately. Perhaps this will be the subject of a separate publication at a future date? However, the book is is clearly a 'must' for all mushrooming in the Appalachians, and will be required by all concerned with the identification, distribution, and ecology of macromycetologists in North America.

The New Agaric Checklist and British Records Anaylsis. By the Association of British Fungus Groups. 2003. Association of British Fungus Groups, Harveys, Alston, nr Axminster, Devon EX13 7G, UK. CD-ROM. Price not indicated.

The need for a new British agaric checklist has long been recognized, since the last was published in 1960 (Dennis *et al.* 1960). A project to produce a fully comprehensive replacement has been in progress at the Royal Botanic Gardens, Kew, for the last few years. But the need was so immediate that the amateur mycological community has now prepared its own new checklist, based on records held in the British Mycological Society sponsored British Fungus Records Database.

The data are arranged by genus or other broader category, and for each species there is the preferred name and synonyms, author citations, numbers of records, vice-county records, and common names.

This is certainly a step forward that will be of value until the critical checklist appears, especially for its entrée into local records through the vice-county details. However, on trying to use the 'Help' file to locate some sample names, no records were found of genera such as *Boletus, Lactarius, Lentinus,* or *Russula*, although that might be excused as these are not *Agaricales* s. str. this is something amateur users would expect. The extent to which this checklist is an advance over what can already be obtained through the British Fungus Records Database is questionable, but that it is available as a CD will mean it has an immediate appeal to those without ready on-line access to the database that spawned it. However, if the genus you want happens to be covered, it may provide extra information to that with which you are already aware, especially as regards local distributions. Nevertheless, you would need to be familiar that the entries had not all been critically assessed by specialists, and should not be automatically be accepted at face value.

In summary, a useful stop-gap for the taxa covered, but one not living up to the first part of its title as a new agaric checklist for the British Isles in the sense of that of Dennis *et al.* (1960). We trust that such a worthy replacement will emerge from the current Kew-based project in the foreseeable future.

Dennis, R. W. G., Orton, P. D. & Hora, F. B. (1960) New checklist of British agarics and boleti. *Transactions of the British Mycological Society, Supplement* 1-225.

ASCOMYCETES

***Onygenales*: the dermatophytes, dimorphics and keratin degraders in their evolutionary context.** Edited by J. Guarro, R. C. Summerbell & R. A. Samson. December 2002. Centraalbureau voor Schimmelcultures, P. O. Box 85167, 3508 AD Utrecht, The Netherlands. [Studies in Mycology No. 47.] Pp. 220. ISBN 90 70351 48 X. Price: € 49.

This is collection of 21 contributions to our understanding of the *Onygenales,* rather than a monographic synthesis. Many include molecular studies, generally supportive of classifications based on morphological and physiological characters, including ascospore ornamentation, but not correlating so well with ascospore shape or wall type. On the taxonomic front, the new order *Arachnomycetales,* nested between *Onygenales* (excluding *Ajellomyces*) and *Eurotiales* is described (but apparently not accepted in the introductory chapter), and four new genera are proposed: *Chlamydosauromyces, Castanedomyces, Pseudoamnauroascus* and *Testudomyces.* There are also descriptions of new species of *Auxarthron, Chrysosporium* and *Oidiodendron,* keys to *Arachnomyces* and *Gymnoascus* species, and a revision of *Mallochia.* Host-shifts feature strongly. DNA markers suggest that there have been host-shifts from animals to humans in the *Trichophyton mentagrophytes-T. schoebleimii* complex, and biological species within *T. mentagrophytes* in North America show host correlations. In *T. rubrum*, asexual lineages with a single mating type are conceptualised as species, unifactorial radiate lineages, derived from a single ancestor but often having undergone host-shifts. The *raison d'être* of the volume is not explained, but I am sure researchers on these important fungi will welcome having so much original research between the same covers at a reasonable price -- and so well presented -- many contributions having first-rate scanning and light micrographs. Those requiring a comprehensive monographic treatment, however, will have to be patient; if this is not already on the agenda of the Editors, perhaps it should be!

LICHEN-FORMING FUNGI

Progress and Problems in Lichenology at the Turn of the Millenium. Edited by Xavier Llimona, H. Thorsten Lumbsch & Sieglinde Ott. 2002. J. Cramer in der Gebrüder Borntraeger Verlagsbuchhandlung, D-14129 Berlin. [Bibliotheca Lichenologica No. 82.] Pp. 326. ISBN 3 443 58061 0. Price: € 88.

This volume is based on papers and posters presented at the Fourth Symposium of the International Association for Lichenology (IAL4) held in Barcelona on 3-8 September 2000. Twenty-eight papers are included in the themes: Systematics of the mycobiont (3), Morphology and structure (1), Lichen diversity and biogeography (5), Molecular approach to lichen phylogeny (2), Lichenicolous fungi (2), Bioindication using lichens (10), Storage and retrieval of lichen data (3), Strategies for the sustainable management of lichen bio diversity (1), and Lichen dominated communities (1). Papers on other aspects of lichens presented at the meeting, notably relating to symbiosis, physiology, and ultrastructure, are being published separately in the journal *Symbiosis.*

The papers of systematic interest deal with *Bacidia* (22 spp. in the Iberian Peninsula, with a key), *Buellia dispersa, Lepraria* and *Leproloma* (in Poland), *Leptorhaphis* (in Hungary), *Lobariaceae* (molecular phylogenetics of the family), *Megaspora* (molecular studies show a close relationship to *Aspicilia*), *Minutoexcipula* (2 spp. nov.), and *Siphula* (synopsis of the genus, with 23 spp. accepted).

The papers included are well-presented and have obviously been carefully refereed and edited, give an impression of an active discipline with many new researchers, but could have easily found outlets in regular journals. The main thrust of the first *Lichenology: Progress and Problems* meeting in 1974 (Brown *et al.* 1976) was to provide in-depth authoritative reviews and updates of the field rather than specialist papers. The title has been taken up by subsequent IAL congresses, but with books remaining out of reach financially to many individual researchers, the wisdom of the separate publication of sets of specialized papers has to be questioned in future.

Brown, D. H., Hawksworth, D. L. & Bailey, R. H. (eds) (1976) *Lichenology: Progress and Problems.* London: Academic Press.

Nordic Lichen Flora. Vol. 2. *Physciaceae.* Edited by Teuvo Ahti, Per Magnus Jørgensen, Hörđur Kristinsson, Roland Moberg, Ulrik Søchting & Göran Thor. 2002. TH-tryck AB, Uddevalla, Sweden. [Available from: Svenska Botaniska Föreningen, c/o Fytoteket, Norbyvägen 16 SE-752 36 Uppsala, Sweden. Pp. 115, coloured photographs 120, maps 123. ISBN 91 972863 5 4. Price: 195 Skr (incl. VAT).

The first volume of this ambitious project was published in 1999 and covered the calicioid taxa (see *Mycotaxon* **75**: 508, July-September 2000). Here, accounts are presented of the 12 genera of the *Physciaceae* in the Nordic countries: *Amandinea, Anaptychia, Buellia, Dilmeleana, Diploicia, Heterodermia, Hyperphyscia, Phaeophyscia, Phaeorhiza, Physciam Physconia* and *Rinodina.* These have been prepared by leading specialists, T. Foucard, H. Mayrhofer, A. Nordin and R. Moberg. The presentation is again excellent with clear keys, descriptions, detailed distributional information down to county, maps, spore drawings (so critical in *Rinodina*), and colour photographs (some perhaps with a somewhat more brownish hue than would have been ideal). The treatment of *Rinodina* will be especially appreciated as there was no modern account of the genus in Fennoscandia and few if any colour photographs published of the species. In this part, there are some nomenclatural novelties gathered together in an Appendix, mainly lecto- and epitypifications, but including two new combinations; 12 species that have been excluded are also listed and there is an index to synonyms. Sadly, molecular work showing that *Diplotomma* has to be recognized as a genus distinct from *Buellia* (but including *Diploicia*) evidently appeared too late to be allowed for (Molina *et al.* 2002). Users should also note that the volume number is incorrectly given as '1' on pages 3 and 4, and the ISBN number is as above (an erratum slip was pasted over the printed number in the review copy). Needless to say all lichenologists will wish to have this in their libraries, and it will surely receive extensive use for the crustose genera particularly throughout the Northern Hemisphere. Now we await the third volume . . . . . .

Molina, M. C., Crespo, A., Blanco, O., Hladun, N. & Hawksworth, D. L. (2002) Molecular phylogeny and status of *Diploicia* and *Diplotomma,* with observations on *Diploicia subcanescens* and *Diplotomma rivas-martinezii. Lichenologist* **34**: 509-519.

Aide Mémoire: *Usnea.* By Peter W. James. 2003. British Lichen Society, c/o The Natural History Museum, Cromwell Road, London SWY 5BD, UK. Pp. 32. ISBN 0 9540418 3 6. Price: £ 3.95.

The identification of *Usnea* species is dreaded by most lichenologists. The inherent difficulties of variations in thallus form in pendent lichens have been complicated in *Usnea* by changing species concepts and also nomenclatural revisions. Peter James has always been determined to understand 'difficult' genera and *Usnea*, especially the British species, has fascinated him for at least three decades. By combining extensive field experience, a critical eye for micromorphological features, and a passion for thin-layer chromatography, he has been able to develop this pragmatic guide.

Summaries of the main features of species, ranged under headings such as 'longly pendulous' or 'isidia only' and a tabulation of secondary chemical components, are followed by personal remarks on the species; these are packed with tips on how to recognize and differentiate the species and information on their ecology and distribution in the British Isles. Four commonly confused species are taken out for special discussion. Finally, each of the 18 species covered has a full-page treatment with notes on the size, ecology, chemistry, and annotated line drawings with enlarged illustrations of diagnostic features and also transverse sections of the thallus. No literature references are provide, which would have been helpful to those wishing to locate more detailed discussions and illustrations of the taxa.

There is only one point I do not understand, the retention of *U. subfloridana* as a separate species from *U. florida.* The difficulties in assigning some specimens to one or the other is recognized, but the molecular data showing that they are conspecific is overwhelming is not mentioned (Articus *et al.,* 2002). This would have been an ideal place to get lichenologists used to the idea that these 'species' are one.

Nevertheless, there is not doubt that all who struggle with the genus will find this of immense value, and be indebted to Peter James for making his extensive expertise on the group so accessible to others.

Articus, K., Mattsson, J.-E., Tibell, L., Grube, M. & Wedin, M. (2002) Ribosomal DNA and β-tubulin data do not support the separation of the lichens *Usnea florida* and *U. subfloridana. Mycological Research* **106**: 412-418.

Atlas typów nomenklatorycznych rodziny *Lecanoraceae* z herbarium LBL-L. By Maria Motyka-Zgłobicka & Wojciech Zgłobicki. 2002. Wydawnictwo Uniwersytetu Marii Curie-Skłodowskiej, pl. Marii Curie-Skłodowskiej 5, 20-031 Lublin, Poland. Plates 75 (colour). [J. Motyka: Porosty (Lichenes). Rodzina *Lecanoraceae.* Vol. 5.] ISBN 83 227 1970 1. Price not indicated.

The four posthumously published volumes on the *Lecanoraceae* of Poland by the late Józef Motyka (1900-1984) issued in 1995-96 (Motyka 1995-96) made nomenclatural history as the first modern taxonomic work to be proposed for inclusion in the list of titles not to be accepted as sources for the valid publication of scientific names under the *Code* (Lumbsch *et al.* 1999). This proposal has been supported by the Committee for Fungi and the work is destined to be included in Appendix V ('Opera utique oppressa') in the next edition of the *Code,* subject to ratification at the Vienna Congress in 2005.

The original work included, amongst numerous other nomenclatural proposals, descriptions of some 220 species as new to science. This fifth volume has colour photographs of specimens of 75 of the 'nomenclature lichen types' of those intended new species preserved in LBL. The reason for the difference in numbers is intriguing: 'The atlas comprises only the photographs of the types whose identification did not raise suspicion (numeration, station consistency)'. This statement implies that there is doubt that the 'types' of around 145 of the intended new species cannot clearly be identified in the herbarium that is supposed to house them. This is a very disturbing situation and provides a further argument to those already put forward that the work should not be accepted as a source of new scientific names.

The species treated appear under the 'names' *Aspicilia* (8), *Koeberiella* (4), *Lecanora* (47), *Lecidora* (1), *Pseudoplacodium* (1), *Semilecanora* (5), and *Urceolaria* (9). For each, two colour photographs are provided, one at actual size (1:1) and the other a 'fragment' magnified 6:1. 9:1, or in one case 12:1. The quality of the photographs is generally very good, although it would have been helpful to know if daylight flash or other artificial light was used as this can affect the resultant colour. No locality, date, or specimen reference number is provided, so for the status of the specimens the authors must be relied upon. It would be interesting to see how easily the photographed specimens could be refound; hopefully they have been clearly labelled in LBL.

While this might be viewed as an interesting new act in this play, its value other than as a curiosity has to questioned in view of the lack of status envisaged for any of the taxa illustrated. That the original work has been proposed for what is in effect suppression (in the sense of the zoological *Code*) is not mentioned in the Introduction.

It is sad that the name of Motyka will inevitably remain associated with such a work, which we will never know if he wished to be printed in the form it was, rather than for his seminal major earlier contributions to lichen ecology and systematics in Poland.

Lumbsch, H. T., Hawksworth, D. L. & Coppins, B. J. (1999) Proposal to add Motyka's four-volume work on *Lecanoraceae* to the 'opera utique oppressa'. *Taxon* **48**: 183-185.

Motyka, J. (1995-1996) *Porosty (Lichenes). Rodzina Lecanoraceae.* 4 vols. Lublin: Lubelskie Towarzystwo Naukowe.

Danish Lichen Checklist. By Ulrik Søchting & Vagn Alstrup. 2002. Botanical Institute, University of Copenhagen. Pp. 43. ISBN 87 987317 4 2. Price not indicated.

This spiral-bound checklist, also available as an internet version on http://www.bot.ku.dk/groups/mycology/dklavar/index.asp, is an update of the checklist produced in 1989 by the same authors, undoubtedly the two leading Danish lichenologists of today. The genera and species are listed alphabetically, together with the Danish common names where coined, indications of the provinces from which they are recorded, and a comment as to their status – a welcome feature not yet seen in many checklists but hopefully to be emulated in future, and perhaps warranted some mention in the title. A traditional view of 'lichen' has been taken, and the work does not cover lichenicolous species unless they eventually form an independent thallus (e.g. *Diploschistes muscorum*). However, some certainly non-lichenized fungi that have been known not to be lichenized for many decades feature in the main list (e.g. *Sarea resinae*) when they might have been expected to be under 'excluded taxa'. Almost a third of the work is a list of synonyms and excluded taxa. Missing are indications of original sources, and where reports have been stated to be errors. The Foreword states that the checklist 'is mainly based on vouchers located in the Botanical Museum, Copenhagen (C), but occasionally also on data from other herbaria and literature', but it would have been useful to have such additional information included. No literature citations as to sources or further information are provided – all topics to consider for a future edition. At least lichenologists in the country now have an up-to-date checklist, and conservationists a single place to refer to for information on the status of species.

Taxonomie, Verbreitung und Ökologie silicoler Süßwasserflechten im außeralpinen Mitteleuropa. By Holger Thüs. 2002. J. Cramer in der Gebrüder Borntraeger Verlagsbuchhandlung, D-14129 Berlin. [Bibliotheca Lichenologica No. 83.] Pp. 214, figs 20, tables 20. ISBN 3 443 58062 9. Price: € 60.

This study of aquatic lichens in Germany blends taxonomy and ecology, with roughly equal parts of the book being devoted to each. The taxonomic focus is *Verrucaria.* Nine species are accepted in the area, but 40 names proposed for these lichens are regarded as synonyms. These decisions have been made following critical morphological comparisons and statistical tests on exciple hights and widths, tissue types, and ascospores (length:breadth ratios proving particularly pertinent). A cladogram showing the relationships of the species based on morphological and anatomical features is included, but no molecular studies have been carried out. A key is provided in which the separations are generally well-made, but it is a pity that trichotomies were not avoided. There are few taxonomic surprises, although *V. pachyderma* is included within *V. funckii.* The accounts of each species include not only descriptions and information on ecology, but habit photographs and schematic sections, detailed discussions of synonyms, notes on allied species, and full lists of specimens studied. The ecological sections cover stream-side zonations, and factors affecting occurrences such as erosion, suspended sediments, light, and the chemical composition of the water; the potential utility of freshwater lichens as bioindicators of water quality is recognized A syntaxonomic (phytosociological) classification of the communities is presented, accepting two unions, and extensive relevé data provided. The interactions with other organisms are reviewed and the fusion of two lichen thalli belonging to different genera (*Bacidina* and *Verrrucaria*) is reported. Cultural studies showed that all subgelatinous species were able to associate with the alga *Dilabifilum incrustans.* This is a valuable contribution to aquatic lichenology in the synthetic German tradition, which will be of interest to all wishing to identify aquatic *Verrucaria*'s or study their ecology world-wide.

LICHENICOLOUS FUNGI

Aportación al conocimiento de los Hongos Liquenícolas de Colombia. By Javier Etayo. 2002. J. Cramer in der Gebrüder Borntraeger Verlagsbuchhandlung, D-14129 Berlin. [Bibliotheca Lichenologica No. 84.] Pp. 154, figs 59. ISBN 3 443 58063 7. Price: € 58.

While studies of lichenicolous fungi have proceeded apace, with 1559 species now known (Lawrey & Diederich 2003), those in the tropics have hardly been studied, with a few notable exceptions (e.g. Aptroot *et al.* 1997, Matzer 1996). Just how rich the tropics are for these fungi is confirmed by this work. Collections were made by Javier Etayo and various colleagues in eight localities in the range 2800-3400 m in Colombia during 1998. The collections yielded 104 lichenicolous species, of which 41 are described as new to science, including four new genera: *Globonectria* (*Hypocreales*), *Hypotrachynicola* (*Ascomycota incertae sedis*), *Nigromacula* (sporodochial conidial fungus), and *Rhagadostomella* (*Sordariales, Nitschkeaceae*). *Hypotrachyna* proved to be an exceptionally rich host in the country with 26 species, seven of which are described as new, seven named only to genus, and two probably representing additional new genera. Some of these fungi certainly need to be searched for elsewhere, for example, *Nigromacula hypotrachynae* had already been described from the UK as *Vouauxiella uniseptata*; it certainly needed a new genus and the combination *N. uniseptata* has now been made (Hawksworth 2003). It was also interesting to see species previously known from temperate Europe or North America had been discovered, such as *Milospium graphideorum, Nanostictis peltigerae, Phacopsis thallicola,* and *Pleospora leptogiicola.* Other noteworthy taxa include the first lichencolous species of the normally lichenized genus *Strigula,* and a second lichenicolous species of the generally plant saprobic *Pezizella.* With so many novel taxa there is always the tendency to 'squeeze' species into genera where they probably do not really belong, for example the three species described here in *Trichonectria*. Very full descriptions and keys for the genera where several members are reported are provided, and there are detailed discussions of the placements and affinities of many species. The photographs and line drawings are of an exceptional quality and must have been prepared with great care. I was also pleased to see that the holotypes of the new taxa had been deposited in COL (Bogotá) where they will be accessible to workers in the country. In summary, a fine work which will be required by all who work on lichenicolous fungi.

Aptroot, A., Diederich, P., Sérusiaux, E. & Sipman, H. J. M. (1997) Lichens and lichenicolous fungi from New Guinea. *Bibliotheca Lichenologica* **64**: 1-220.

Hawksworth, D.L. (2003) The lichenicolous fungi of Great Britain and Ireland: an overview and annotated checklist. *Lichenologist* **35**: 191-232.

Lawrey, J. D. & Diederich, P. (2003) Lichenicolous fungi: interactions, evolution and biodiversity. *Bryologist* **106**: 80-120.

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CONIDIAL FUNGI

Genetic Diversity of *Colletotrichum gloeosporioides* Penz. causing Anthracnose Disease of Yam (*Dioscorea* spp.) in Nigeria. By Mathew Musumbale Abang. 2003. J. Cramer in der Gebrüder Borntraeger Verlagsbuchhandlung, D-14129 Berlin. [Bibliotheca Mycologica No. 197.] Pp. xi + 139, figs 19, tables 15. ISBN 3 443 58099 3. Price: € 40.

Not a systematic work in the strict sense, but one with which those concerned with *Colletotrichum* taxonomy should be aware because of its scale and contribution to our understanding of the extent of host specificity amongst *C. gloeosporioides* isolates. 217 isolates obtained from yams and some other hosts conforming to the morphospecies *C. gloeosporioides* were tested for virulence against a set of *Dioscorea alata* cultivars. This enabled a remarkable 18 pathotypes to be distinguished, most causing moderate symptoms or not being virulent to yams. Of especial taxonomic interest is that isolates from many hosts other than yams were able to attack yams and were not just able to grow on the hosts from which they were isolated. Such hosts clearly have the potential to act as reservoirs of anthracnose-causing inoculum. The identity of the strains as *C. gloeosporioides* and their distinction from other members the genus was confirmed by ITS sequences. Vegetative incompatibility tests using mutant strains corroborated the conclusion that the same species occurred on yams and weed hosts. However, isolates from different cultured colony morphotypes were not compatible, and in some cases more than one vegetative compatibility group was represented in a single leaf lesion. In addition, a microsatellite approach was used to study population structure; most variation was within population, and no geographical correlation was discovered. A partially purified but unidentified phytotoxin was also extracted from disease-causing isolates. The *Guignardia cingulata* teleomorph occurs in the country and its ascospores are considered as the likely agents for its long-distance dispersal. A most commendable piece of work

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Erratum

Vol. 80, October-December 2001

The two pages following the blank page on the reverse side were incorrectly printed. You can remove that two-sided sheet (pages 93 and 94) and substitute in for the incorrectly printed pages 93 and 94 in volume 80, or you can annotate the original volume in pen or pencil to indicate that the correct pages are printed here.

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ERRATA

VOLUME EIGHTY

Page 73, line 51	for	*Mycotaxon*	read	*Mycotaxon* ***80:*** *77-95.*

VOLUME EIGHTY-SIX

Page 375, line 21	for	*Brunnipula*	read	*Brunnipila*
Page 470, line 46, 50	for	*terreii*	read	*terrei*
Page 470, line 48	for	*cinnabarina*	read	*cinnabarinum*

VOLUME EIGHTY-SEVEN

Page 38, line 16	for	*melanosporus*	read	*melanoporus*
Page 85, line 14	for	*Stigamatidium*	read	*Stigmatidium*
Page 145, line 26	for	*trignosporus*	read	*trigonosporus*
Page 149, line 40	for	*acufomris*	read	*acuformis*
Page 163, line 30	for	*var. gossypi*	read	*var. gossypii*
Page 235, line 31	for	*trevelyanii*	read	*trevelyani*
Page 460, line 8	for	*Zalerium*	read	*Zalerion*

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